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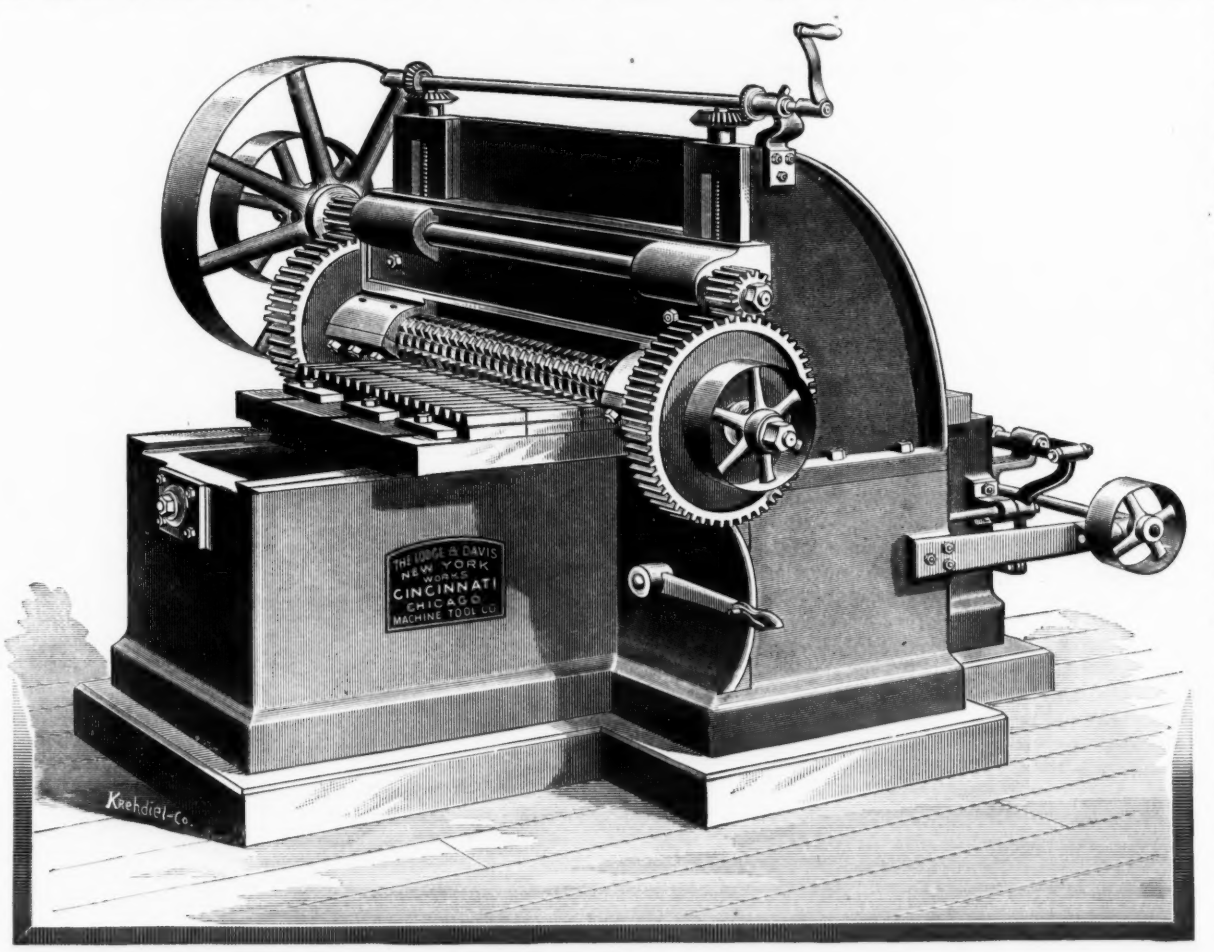
Slab Milling Machine.

The accompanying illustration is of a new slab milling machine designed for the heaviest work within its nominal capacity, which is, to take in 38″ between housings, the length of the platen being 60″, and, the extreme height from the platen to the center of the cutter arbor 11″. The platen is gibbed and dovetailed to the bed, is fed by a large screw which is placed under it, and there is a quick-return motion which is operated by the lever seen at the right of the machine. Cutters are changed by removing the caps from the bearings, these being placed at such an angle that the cut tends to force the arbor against the solid metal of the bearings. The machine weighs 6,500 pounds, and has sufficient power to cut three-pitch racks, as shown, 30″ long, at one cut. It is built by the Lodge & Davis Machine Tool Company, Cincinnati, Ohio.



SLAB MILLING MACHINE.

A Still Larger Telescope.

Our readers are, of course, nearly all more or less interested in the Lick telescope, regarding which we have had something to say in former issues, and which was built by Warner & Swasey, of Cleveland. This telescope is now to be somewhat exceeded in dimensions by what will be known as the Yerkes telescope, which will be part of the equipment of the Chicago University, and which will have an objective of 40″ clear aperture (not 45″, as we erroneously stated), this being 4″ larger than the Lick. The contract for this new giant was awarded to Warner & Swasey recently, and there is some idea of rushing its construction through in time to exhibit it at the World's Fair, though it has not been definitely decided to do this. Some figures relating to the new giant may be of interest. The tube, with its accessories, will be about 70 feet long, and will weigh about 6 tons, the total weight of the instrument being about 60 tons. The polar axis will weigh 5 tons, and the clock, which will move the telescope in unison with the movement of the heavenly bodies, will weigh about one ton, and will be placed, as in the case of the Lick, within the cast pedestal or base of the instrument. This base or column will weigh about 30 tons. The telescope will be arranged to be moved either by the clock, by hand, or by electric motors, as the observer may desire. The light-gathering power of this lens will be about 25 per cent. greater than that of the Lick, and it is thought that the available magnifying power will range from 250 to 3,000 diameters. But, as we have before intimated, it is very doubtful indeed if the work done by this telescope exceeds that of the Lick, because the conditions for astronomical observations are certainly 25 per cent. better on Mount Hamilton than in Chicago; if, indeed, the difference in favor of the Lick telescope is not even more than this. The re-mounting of the Naval Observatory telescope at Washington, which was undertaken by Warner & Swasey some time ago, is well under way, and when this and the Chicago telescope are completed, they will have the honor of constructing the mechanism for the two largest refracting telescopes in the world, and the three largest in this country, while the character of the mechanism is above criticism, the re-mounting of the Washington telescope being done especially to secure the latest and best-constructed mechanism.

Chilled Car Wheels.

BY S. BOLLAND.

American car wheels are generally made of chilled cast-iron. Some wheels are cast with spokes, and others, for light purposes, are made with a single plate betwixt the hub and rim; but the "Washburn wheel," which has an arch at the central portion, adjacent to the hub, the apex of which is connected by a curved web to the rim, as shown at Fig. 1, is the one most generally manufactured in this country; the large number of extensive plants engaged in their production giving ample testimony to their popularity.

These wheels are subjected to very hard usage, and must naturally sustain shocks and strains of an extraordinary nature, consequently none but the very best brands of soft strong iron are used in casting them. Moreover, these irons must possess the quality of taking a "chill" readily, the depth of which may vary from ¼″ to 1″, according to the mixture. The proportioning of these several brands of iron to obtain the requisite strength and depth of chill is unquestionably the most important operation in their manufacture.

The part of the wheel to be chilled is, of course, the outer circumference, or "tread," including the flange. This surface, to the depth of half an inch or more, is by the process of "chilling" converted into white iron of a hard, crystalline, but brittle nature; almost like steel physically and chemically, excepting that it cannot be tempered.

When the rims of these wheels are broken the fracture should show a bright steel color at the chilled part, gradually diminishing in hardness towards the body of the wheel, where it should be soft and tough. In the following brief review of their manufacture we shall confine ourselves, as near as possible, to the practical side of the subject. Beginning with the pattern and following the casting through all the various processes, including annealing, we shall discover how much work, mental and physical, there is expended in the making of a chilled car wheel.

PATTERN.

A true and well-made pattern is a chief desideratum in the manufacture of chilled wheels, for not only is it possible that chill cracks, which are manifestly more frequent when some particular pattern is used, but also other defects which a crucial series of tests prior to a final delivery reveals, may most assuredly have their origin in a faultily-balanced and unevenly thicknessed pattern.

Knowing that a wheel pattern cannot escape more or less rough treatment in the foundry, it is only common sense and wise on the part of the pattern maker to make all exposed parts of his pattern out of hard wood. Some places prefer to turn up an iron pattern for this class of work.

It is a common practice to make the chamber core-boxes of iron, after the manner shown at Fig. 2 (page 2), in which boxes the cores remain until they are dry. The operation of making the core is plainly shown; the lower side *A*, *A*, with prints for vents *B* being made in the core-box itself, whilst the upper side *C* is formed by the sweep *D*, which, as seen, is made to travel around the top, guided by the center pin *E*, and from the upper side of the core.

Ordinarily this completes the making of this core until it has been dried, but if the method suggested be adopted, it will be necessary to place a template with three evenly-divided holes over the core when it has been swept off, by the aid of which a small iron bearing can be pressed into the core, level with the surface, and directly under each chaplet's place in the cope, as seen at *A*, Fig. 3. The object of this is that a short shouldered stud ⅝″ diameter may be used instead of the heavier one usually employed for that purpose.

Even the center core, simple as it may seem, is worthy of more than ordinary attention in this case; nothing should be left to chance, as we may rely upon it that a flattened core placed out of truth will naturally interfere with that equality of cooling so essential to success in this work. To avoid this it is advisable to use iron core boxes that will give a perfectly true core every time.

MOLDING, FLASKS, CORES.

The whole operation of molding a chilled wheel is clearly shown at Fig. 3, which is a representation of the entire mold when closed and ready for casting.

It is usual to hold all the parts together by clamps, or bolts, at the lugs provided for the purpose (those for cope and chill are to be seen in the figure), having separate ones for pinning the nowel and chill together; the cope, not requiring pins, necessarily being bolted fast to the chill when it is placed theron for ramming.

This figure shows the application of strong pins and keys *A*, *A*, for all the parts, thus obviating the annoyance consequent on the use of either of the former mentioned methods; a few keys being in every sense an effective substitute, and requiring only a blow from the hammer to either fasten or loosen them.

The plan view in this figure explains at once the class of cope in general use, and gives the position of all lugs as well as that

of the swivels, or trunnions *B, B*, which are cast on the chill only.

The perforated bottom plate *C, C*, is represented as strengthened by an outer ring *D, D*, and an inner one *E, E*, which are connected by cross-ribs; this plate may be pinned and keyed after the manner shown for cope and chill. The only way to make this method of pinning absolutely effective, in any case, is to have all lugs made extra strong and large, to make the pins as short as possible, and in this particular instance the latter should be not less than 1″ diameter at the thread and 1¼″ above the shoulder, at *F, F*.

However true the pattern may have been made, it will avail but very little in producing a true casting if care is not exercised in ramming up the mold. This operation must, of necessity, be intelligently performed, and all good wheel molders are cognizant of the fact that hard, even ramming is the only way to success in this work. The sand chosen for the bottom of the mold should be of a very open nature and used not overmoist; that for the cope may be selected with a view to having good adhesive qualities in combination with those mentioned above, as every effort is made to make the sand hang in the cope without the aid of lifters or nails, if possible.

The best efforts of leading proprietors have been constantly directed towards improving their methods of molding chilled wheels, until now, by the adoption of the pneumatic system, it has been made all but perfect; the latter power is manageable to a remarkable extent, moving either fast or slow, as it may be desired. This is productive of an increased output with a diminished expenditure of labor, thus making it advantageous to employer and employe, as the latter usually works by the piece.

The operations of molding are, first to place the cope on its back with the chill attached, into which the pattern is then placed and the nowel pinned on and rammed, to be afterwards vented. The bottom plate is then made fast to the nowel and the whole turned over by means of a double sling made to fit the swivels on the chill and bowed sufficient to allow the entire set of flasks to turn over clear of everything.

When over, and resting *level* on the floor, the cope is rammed and vented, and the pouring basin *J*, formed, after which the chill is lifted off and reversed. This brings the cope along with it, exposing the impression of the top or cope side, the impression of the lower or nowel side being seen when the pattern is lifted out. There remains little to be done now except finish and blacken these two parts and place the chamber and center cores in their respective places; the cope can then be again reversed and closed over after the studs *A* have been inserted, as shown.

These studs form a handy and effective means of holding down the chamber core, and require no attention after the mold is closed. The vents from the cores are taken away at the bottom plate, after the manner shown at *G* and *H*.

CHILLS.

With very few exceptions, chills are invariably made of cast iron.

How deep the chill may be formed in castings cannot safely be determined by any other means than actual previous test of the mixtures to be used.

The depth of chill in a casting is, to some extent, dependent on the bulk of metal contained in the chill.

The smallest possible thickness of chill necessary to produce a desirable chill on car wheels, when the mixture is in every sense favorable, is about the same as the thickness of the rim to be chilled; but on account of the hard usage to which they are subjected it is usual to make them much heavier; still, this increased thickness produces very little increase in the depth of chill obtained by the thinner ones.

The chill reduces the temperature of the metal with which it comes into immediate contact almost instantly, but if the casting is of very heavy proportions, the chill should be made thick enough to effectively absorb whatever heat must subsequently pass from the casting outwards, and thus prevent the already chilled surface from being re-melted.

Metal for chills should be of the same nature as that used for the castings which are to be cast therein, viz., extra strong, and fine-grained. All irons of a highly graphitic nature should be discarded, on account of their openness of grain.

The chances for chill cracks will be materially lessened by having the flasks level for pouring; likewise if the iron is allowed to cool, before running it into the mold, to as low a degree as will just run a smooth surface on the chill without seaming, there will be less danger of the above unpleasant experience.

It is claimed by some that a deeper chill results from having the chill made hot; whether this be so or not, it is always preferable to have them at least warm enough to prevent any moisture from settling upon them.

Chills for car wheels should be bored out, and well polished to a very smooth surface, after which the surface is to be slightly rusted by the application of some dilute acid. This rust is to be afterwards rubbed off, and the surface touched over with a thick paste, composed of black lead and oil, before casting. There must be none of the paste left on the chill; the idea is to rub the lead well into the pores of the metal, and thus prevent the molten iron from finding a lodgment there.

When not in use, place all chills in a dry place, and cover the polished surface well with grease, taking care to clean well when they are again brought into use.

THEORY OF CHILLING CASTINGS.

The chill acts upon the surface of the molten iron by rapidly absorbing the heat at the point of contact. This brings about rapid cooling, and cast-iron is hardened by rapid cooling, as may be satisfactorily proved by casting four plates—equal in area, but of different thicknesses—from the same ladle of iron. The one at 1″ thick will be gray and soft, the one at ½″ thick will be perceptibly harder and more dense, the one at ¼″ thick will be still harder, with evidences of mottle in parts, and the one at ⅛″ thick may be absolutely white, plainly showing that the change from gray to white has been effected by the difference in the rates of cooling.

How this change occurs is explained thus: It is supposed that whilst cast-iron is in a molten state all its carbon is held in combination, and that when this carbon amounts to some 2½, or upwards, per cent.

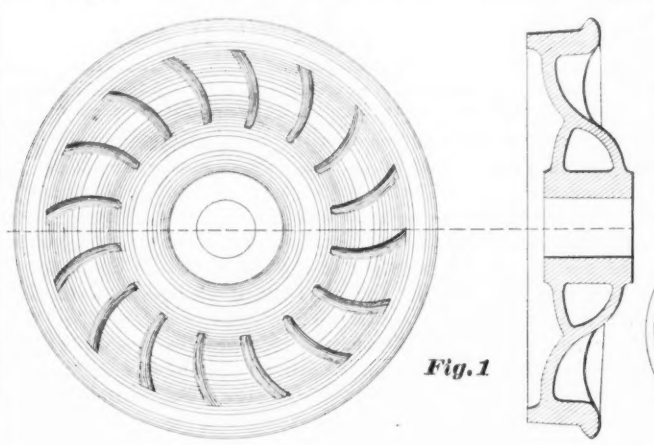


Fig. 1

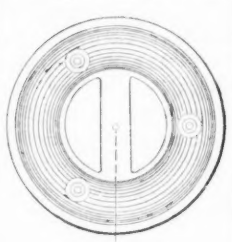
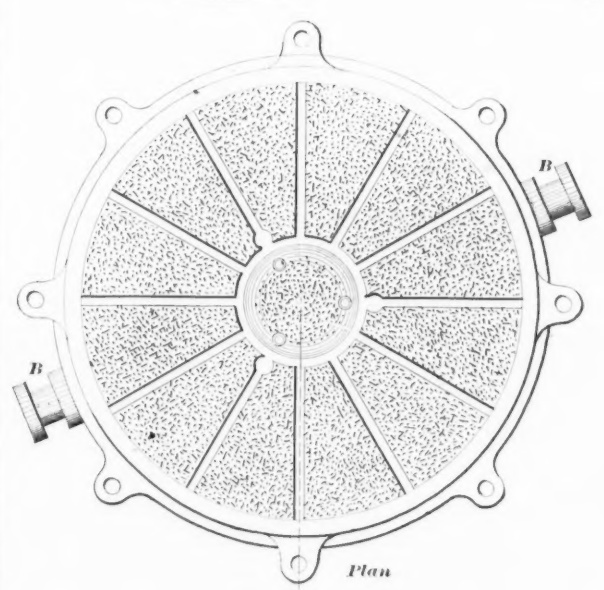


Fig. 2



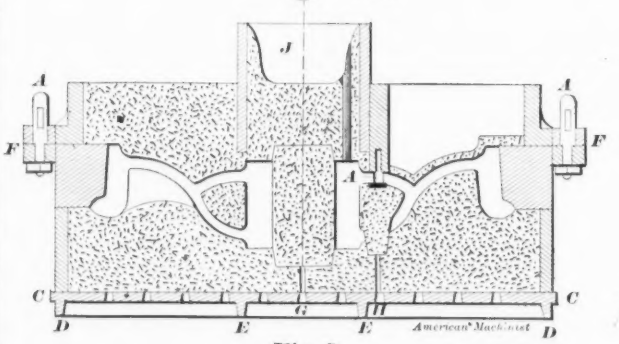


Fig. 3

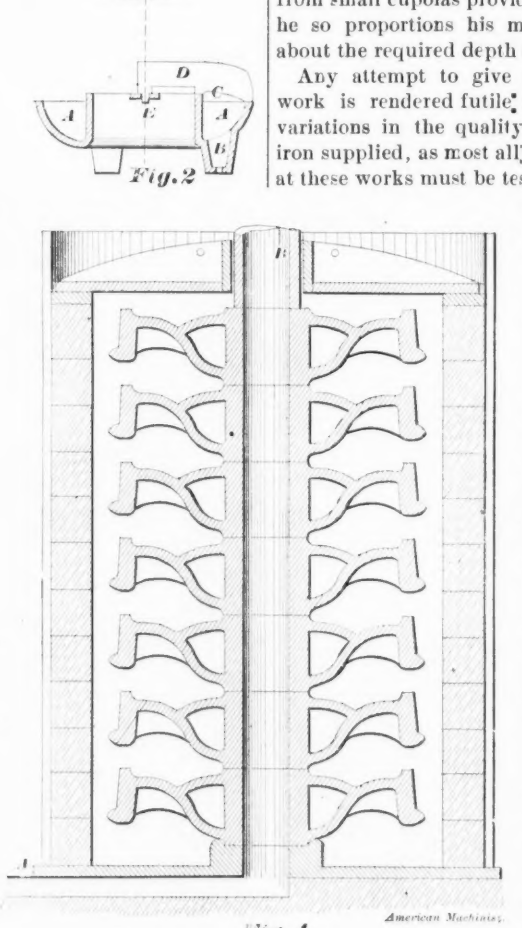


Fig. 4

The above facts lead us to these conclusions, that by the sudden cooling of the molten iron, caused by its intimate contact with the chill at the rim of the wheel, the carbon at that portion is held in chemical combination with the metal, any separation of combined carbon into graphite being prevented by the rapid cooling spoken of.

On the other hand, the natural separation of graphite, superinduced by the slower process of cooling which takes place at the inner parts, goes on with an easily discernible tendency to a maximum degree of softness at the center of the wheel, that point being the last to become cold; consequently we have a rim hard as hardened steel on the tread, the remaining parts becoming gradually softer and more tough as the center is approached.

METAL MIXING, CASTING.

As previously affirmed, the mixing of the metal for car wheels to be chilled is pre-eminently the chief feature in this remarkable industry, and can only be accomplished satisfactorily when conducted by some responsible person whose only business it is to make selections from an intelligently graded stock of irons, chiefly charcoal, which are supposed to possess qualities suitable for this class of work especially. By unremitting attention to the results of tests made daily from small cupolas provided for the purpose, he so proportions his mixtures as to bring about the required depth of chill.

Any attempt to give mixtures for such work is rendered futile, on account of the variations in the quality and nature of the iron supplied, as most all of the iron received at these works must be tested by the fracture and graded by the mixer in a manner intelligible only to himself.

To insure a thorough mixing of the iron when melted, so that no portion of the metal used shall vary in the slightest degree from what has been previously determined by the mixer, a large tank or receiver, geared for turning, is provided, which stands immediately in front of the cupolas and receives the molten iron from each at as many spouts as there are cupolas. The capacity of these tanks varies according to requirements, from 10 to 20 tons.

By means of this method a large supply of well-mixed metal is constantly on hand for filling the casting ladles, which are usually run under the lip of the receiver on trucks. When filled, they are quickly run towards the crane (each floor in most places being provided with an independent crane) for casting.

Where so large an amount of iron is handled by this means, it is important that everything be hot to commence with, both ladles and receiver; therefore a plentiful supply of charcoal is always on hand for that purpose, the surface of the receiver being especially cared for in this respect.

Almost as soon as cast, preparations are made for releasing the wheels, which must, whilst red-hot, be dispatched to the annealing ovens, where, by a slow process of cooling, the tension of the particles of metal are equalized, and the wheel rendered more able to stand the hard wear and tear of railroad usage.

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as in the period of cooling, according to the nature of the metal operated upon.

Considerable attention has been directed to this subject, the object being to make the web soft and tough, that it might withstand the jar and strain incident to use, and, at the same time, have a hardened rim that will bear the wear.

In order to accomplish this, ovens or annealing pits are provided in sufficient number and capacity to take in all the wheels as they are cast. These ovens, usually set level with the floor, are so arranged that a constant emptying and re-filling may be kept up without interruption, and are sometimes made of sheet-iron cylinders lined with brickwork, the whole resting over a flue or heat chamber, which connects with a furnace, from which latter the heat passes through the chambers into the ovens at the bottom. A very small amount of fuel is sufficient for this purpose, the object being to simply prevent the castings from cooling too rapidly.

Three days is the usual time allowed for annealing.

The processes of annealing are not, however, the same at all places; some merely place the wheels in a pile in cylindrical pits provided with non-conducting jackets, which protracts the period of cooling, and contributes to the effectiveness of the operations.

Another method is to pile them in the oven symmetrically, and allow a blast of air to be carried through the centers of the hubs which form a continuous duct to the top, as seen at Fig. 4. Dampers may be placed at the inlet *A*, also at the chimney *B*, affording means for regulating the passage of air, and thereby modifying the rate of cooling. By this means the wheels are induced to commence cooling at the centers, the cooling gradually extending outwards. In this instance the heat is at no time sufficient to "draw the chill," and for this reason is to be preferred to some other methods which are open to objection on that account. The figure shows only seven wheels, but it is common to pile from 10 to 15 in one pit.

In some other places, layers of charcoal are placed between the wheels as they are piled in the pit, which is so arranged that the quantity of air may be graduated to regulate the combustion.

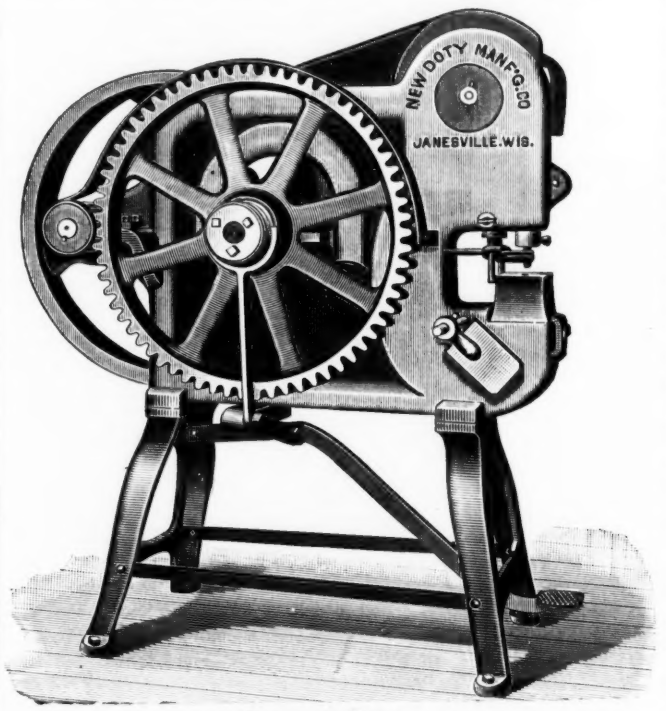
Another method is to insert intervening rings, so placed as to separate the chilled tire from the web which is to be annealed. The interior space around the hubs is filled with charcoal, and the outside space around the tires is filled with sand. The charcoal, being ignited by the heat of the wheels, burns slowly, and anneals the web, while the sand protects the tread from the same action, thus, it is claimed, retaining the chilled surface which it has acquired in casting.

An improvement on the preceding method is claimed for a mode of introducing the air draft and in the mode of isolating the tires. The wheels are piled upon supporting rings at the bottom of the oven, so that a passage is formed by the holes through the hubs for cold air, and another passage around the tread of the wheels for the draft, for burning the charcoal which is distributed upon the perforated flanges of the ring interposed between each wheel. The openings in the base of the annealing oven are the means of admission of atmospheric air to aid in the combustion, and this supply is graduated to suit the requirements of the case; another opening admits the air to pass upwards through the hubs.

It is needless to state that where chilled wheels are made in great quantities the very best appliances for handling are indispensable. For a long time steam and hydraulic power has been utilized at all such places, the latter principle serving a good purpose at the annealing pits where red-hot wheels must be handled quickly; but of late compressed air has come into use for power in the car wheel foundries, with eminent success.

The use of compressed air has been adopted at numbers of places where steam was found to be objectionable on account of the noise when escaping, and the general dampness around, also at other places where it was thought desirable to avoid the annoyance from leaking, and loss of time, usually incident to a hydraulic system.

Whatever principle of oven is used, it is important that the wheels, as soon as set, almost, be taken out of the flasks and placed therein whilst red-hot, and before any of the strains incident to unequal cooling should come upon them. This is done with a marvelous degree of alacrity at some places by aid of the splendid equipment provided, the wheels are rapidly relieved from the flasks, placed on trucks and run to the ovens direct, where they are again as rapidly lifted and piled into the ovens and straightway covered up. In some shops the annealing ovens are in the immediate vicinity of the molding floor, in which case they are piled direct as they are lifted out of the sand; where this can be done it is unquestionably the better plan.



PUNCHING PRESS.

TESTING.

After the allotted time for annealing has expired the wheels are lifted out of the ovens and transferred to the cleaning rooms, where the fins and sand are removed; after which they undergo such a testing as would naturally startle any one accustomed only to the lower grades of cast iron.

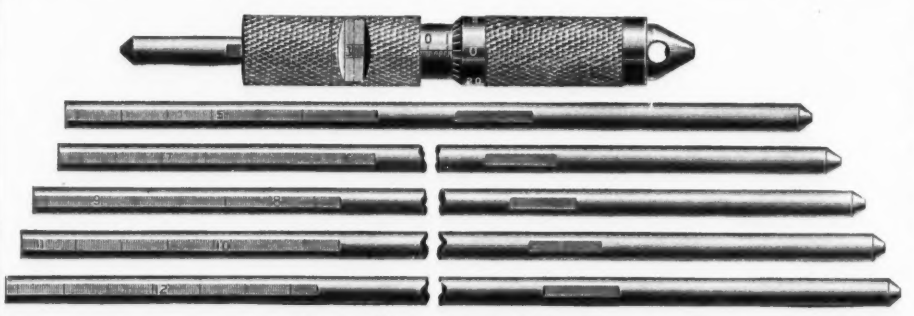
No effort is spared to discover flaws of any description; cracks soon reveal themselves under the heavy sledging they receive, and dirt spots are soon discovered by the sharp pick which in most places is freely used over the surface. The chill also receives its share of attention, to make sure that it is deep enough, or not too deep; a fault either way condemning it at once.

Punching Machine.

We illustrate with this a machine adapted to punch holes up to $\frac{3}{4}''$ diameter in iron or steel $\frac{1}{2}''$ thick, or equivalent work. The body or frame of the machine is cast in a single piece, and the boxes for the shafts cast with it, and this principle of casting or forging as many parts in one as possible is carried out all through the machine, to secure strength and rigidity. The clutch is so arranged as to be convenient to operate, and is quick, positive and quiet. By it the punch can be stopped at any part of its stroke, either up or down. The machine has an improved stripper, which can readily be adjusted, and as nicely or accurately as may be required for any work. All necessary gauges and gauge rods are also supplied. Tight and loose pulleys form a part of the machine, so that when it is placed in position it is ready to run. The machines are made in six sizes by the New Doty Manufacturing Co., Janesville, Wis.

Inside Micrometer Caliper.

In our issue of July 28 we illustrated and described a combined inside micrometer caliper and depth gauge, which was constructed upon much the same principle as that of the present tool, which is intended for inside measurements only. Provided with the set of six wires, as shown, the range of the caliper is from $2\frac{1}{2}''$ to $13''$, the range of the micrometer screw, $\frac{1}{4}''$, affording facilities for measuring by thousandths of an inch from various base lines marked upon the wires $\frac{1}{4}''$ apart. The ends of the wires are made as hard as possible, so that wear is reduced to the minimum, but to provide for what wear does take place, a single line is marked on each wire, as shown, these lines being at the same distance from the measuring end of the wire in every case. When the tool is to be tested for wear, the micrometer screw is run back, and a wire inserted with the hardened point inside. It is pushed down until it comes in contact with the end of the micrometer screw, which is then advanced until the test mark matches the mark on the body of the tool. One after another all the wires are then pushed in against the screw, to see if all the lines match; if not, then the longer wires are lapped down to agree with the shortest one, and the tool readjusted by turning the hardened cap at the other end, above the micrometer screw, a pin being provided for this purpose, and the cap being screwed into the body of the tool a tight fit, so that it is not liable to be accidentally disturbed. It is made by J. T. Slocomb & Co., Providence, R. I.



INSIDE MICROMETER CALIPER.

By a court decree, the South Carolina Railway must be sold for the benefit of its creditors. Daniel H. Chamberlain is appointed special master to make the sale at public auction at the United States Custom House, in Charleston, on April 11 next. The special master cannot receive any bid for a less sum than $1,000,000. The Louisville and Nashville people will probably bid for the property.

A boiler explosion in Hoboken, recently, resulted from a man assuming charge of the plant who knew nothing about the running of a boiler; so it is generally.

An Interesting Boiler Explosion.*

BY FRED. H. DANIELS, WORCESTER, MASS.

In these days of high-pressure steam, the construction of boilers becomes a study of great interest. Responsible makers are alive to the question, and use all possible means to insure the strength and safety of their product, in order to prevent more or less disastrous failures. Accidents will, however, occur, and when they happen, engineers are always ready to study cause and effect, in order to draw some conclusions which in the future may be of great value. A report upon a peculiar rupture which took place in one boiler of the steam plant of the Washburn & Moen Manufacturing Company, Worcester, Mass., may therefore be of interest to many of our society.

Six years ago they equipped a portion of their plant with a battery of six horizontal tubular boilers, from plans furnished by H. S. Robinson & Co. The boilers were 5 feet in diameter, with tubes 19 feet 8 inches long, and were designed to carry a working pressure of 125 pounds to the square inch. The advantages of subjecting materials for boilers to a careful test by the consumer, before accepting them, were brought to our attention by Mr. H. S. Robinson, senior member of the firm mentioned, and we decided to have all the materials for our boilers, especially the shell plates, tested in a very exhaustive way at the Watertown Arsenal, before permitting any of the material to be used. One plate out of the entire lot was condemned. These boilers have been in successful operation for nearly six years, and are still in use. They are inspected every week. The water is run out, the man-holes removed, and the interior, as well as the exterior of the boilers, carefully examined. As the water in the streams in the vicinity of Worcester is very pure, coming as it does from the granite hills, we never find scale in the boilers, but in the spring and fall, during high water, it is not uncommon to find a small deposit of debris, which is carefully washed out.

With all this care, the accident was to us a real surprise. When it happened, the plant was running as usual, but the boilers were somewhat forced, although not to any extreme limit. Without any warning whatever, and with very little noise, the firing doors of the furnace were burst open, coal, ashes and water thrown out, and the boiler house, in an instant, filled with steam.

As soon as an examination could be made, it was found that one of the plates in the third row, just over the most intense heat, had bagged and ruptured, leaving an orifice about one inch in diameter, thinning the metal around the orifice to a knife edge. The remainder of the shell was not damaged, because the boiler quickly emptied itself of water and steam, which extinguished the fire and cooled the brickwork. The accompanying drawings (Figs. 1 and 2) illustrate the exact location of the rupture, also the arrangement and details of the boiler and setting. A careful inspection failed to discover scale or debris of any kind inside the boiler. The other five boilers of the battery were also examined at the same time, and we found two of them with their lower sheets slightly wavy, but nothing approaching a bag. The ruptured portion was cut out, and a patch supplied in its place. The boiler has been in constant use since, without any further sign of failure.

Upon examination of the cut-out piece (exhibited at the reading), we found a very thin black scale around the rupture, and nearest the orifice it looked as if the plate had been highly heated, so highly, in fact, as to permit the cutting away of the hot metal. We carefully calculated the cubical contents of the plate (see Fig. 3), and found that there were 1.41 cubic inches less material in the half 10-inch circle, after rupture, than there was in the plate before. These figures, together with a careful examination of the plate, seem to indicate that for a few moments before the rupture the plate was

*A paper read at the New York Meeting of the A. S. M. E.

subjected to a very high, possibly to a white heat, and when the metal became sufficiently plastic, and was in a proper condition for such a result, it simply flowed out, as shown in exhibited plate herewith, or in Figs. 4, 5, 6 and 7. It seems reasonable to suppose that this plate had been overheated for a very few minutes only, and that previous to the time of rupture it had been in perfect condition, for the boilers were carefully inspected only four days previous to the accident, and everything was found in good order. Two or three times during the past twenty years we have had boilers bag, but never before had one rupture.

All of the shell plates in this battery of boilers were stamped with numbers, and the original report on the tensile strength tests preserved By referring to these records we found that the plate which was ruptured had on one end a tensile strength of 68,050 pounds, and on the other end 65,650 pounds per square inch. It also stood well the "burr test" for annealing and water chilling (see exhibit of "burr tests," how they are made). By way of comparison, two test pieces were planed from the ruptured plate (test pieces were exhibited at the reading. See also Figs. 8 and 9). The test piece which was farthest from the bulge held 60,486 pounds to the square inch, and had a reduction of area of 41 per cent. The test piece close beside the rupture held 61,666 pounds to the square inch, and had a reduction of area of over 32 per cent. It will be observed that the tensile strength is considerably less in the ruptured plate than in the original tests of the plate. This may be accounted for, however, by reason of the test piece having a twist in it, occasioned by the bulge in the plate, and having been put into the testing machine without straightening. "Burr tests" were also made. One of them, heated high and allowed to cool in the air, was hammered together as shown; the other, heated to redness, and plunged in cold water and hammered as shown, without failure (exhibited "burr test" made from the bulged plate). The analysis of the ruptured plate is as follows:

Phosphorus	.063 per cent.
Sulphur	.022 per cent.
Silicon	.024 per cent.
Manganese	.261 per cent.
Carbon	.10 per cent.

It has been suggested that this thin scale covered the entire surface over the fracture before the rupture, and was caused by oil which had become burned onto the plate; but as the feed water for this plant was supplied from a closed heater, it is difficult to see how oil could have found its way into the boiler. We have been informed by Mr. Robinson that he was called, a short time ago, to examine a boiler of the same construction as the one referred to in this paper. It had been overheated directly over the fire box, making the shell plates wavy. After carefully drawing the water from the boiler, nothing could be discovered on the plate excepting a whitish powder. There was neither scale nor mud.

The conclusions the writer arrives at are, that the importance of mechanical, physical, and chemical tests cannot be overrated. While the plate makers invariably subject their plates to tests, and stamp them accordingly, at the same time a confirmation of quality by the consumer is desirable, for we have seen that, in the tests at Watertown, one plate was condemned. If the ruptured plate had been of improper material, or had contained sufficient carbon to harden when the water came in contact with the overheated plate, a crack might have developed, resulting in a serious explosion, possibly destroying the entire plant, and causing a loss of life.

In closing, we wish to compliment Mr. H. S. Robinson, who constructed these boilers for us, upon the very perfect system which he has had in use for the past nineteen years, of checking the tests of plates to be used in the work produced by his firm. During this time, all the plates of the boilers produced by them have been re-tested, and a complete record preserved of the tensile strength and the "burr test," at the same time recording the location of each plate in the boiler by properly stamping them. This system is of great value to him and to the consumer, for any defects can then be traced and fully investigated.

The paper was discussed first by Mr. Allan Stirling, who had previously drawn upon the board a sketch of such a boiler as was under discussion, and his idea was that in a boiler of this design the formation of steam was so rapid that the water could not remain in contact with the sheets over the hottest parts when the boiler was pushed.

Mr. James McBride said that he had had a similar case, and that one word of four letters explained the whole trouble—that word was—dirt. In this case, when the trouble occurred, the engineer reported that the boiler had been recently cleaned, and was clean. Nevertheless, an examination showed that it was not clean, and by means of a hook made for the purpose, a half pail of scale was removed. Though subordinates do not mean to deceive in these matters, or to prevaricate, they are often mistaken. The speaker did not believe it was possible to put in a fire hot enough to burn that sheet if the boiler is perfectly clean.

Mr. John T. Hawkins thought the character of the circulation established in such a boiler was such as to form a sort of pocket or a lifting of the water from the sheet on the bottom, and along the center line just over the hottest part of the sheet, this resulting possibly from the meeting at the center of two opposing streams, which descend at each side, and meet at the middle, where they must unite and be deflected upwards.

Mr. F. H. Laforge thought there was little use in charging the trouble to defective design, lack of circulation, or lack of contact, because we have so many thousands of just such boilers that are operated successfully for years up to 30, and when there was a bulge there was a cause for it, and this was usually dirt. He remembered an engineer who used zinc in his boiler; he would throw in a shovelful of zinc chips in the bottom of the boiler, and shortly after he found the sheet bulged over the fire. The solution of such troubles was to keep boilers clean.

Mr. C. W. Nason said he remembered a case of bulging similar to this if it had gone far enough, in which the trouble was clearly due to lamination of the sheet; an examination of the bulged portion, which was made after it was cut out, showing that the sheet was in two parts, separated by a measurable distance, so that the portion next the fire was undoubtedly heated red-hot and bulged, and the inside portion, being thin, gradually stretched and went with it.

Mr. Barnet Le Van said three such cases coming under his observation were caused by a bunch of greasy waste being left in the boiler.

Mr. H. B. Roelker instanced a case of lamination of a steamboat boiler, in which the lamination passed diagonally through the sheet from one side to the other; this caused a leak, which was investigated, and the trouble remedied. That boiler was clean.

Mr. Holloway said this seemed to be a guessing match, and his guess was that the thinness of the edge of the opening in the sheet indicated that the trouble must have been caused by a blister or air bubble in the ingot from which the sheet was rolled. He knew there were steel makers present who would say that such things do not occur, and would get up and say so after he got through, but nevertheless he thought likely this was the cause of the trouble.

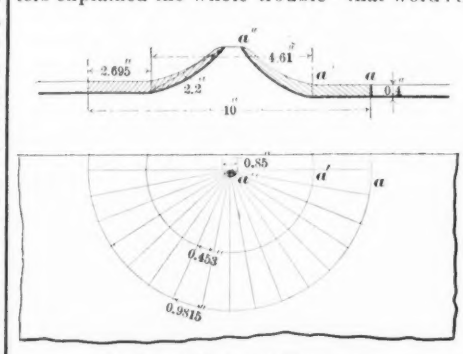
Mr. Geo. H. Babcock said it might be set down as an axiom "that no sheet of metal of reasonable thickness, used in ordinary boilers of this character, if perfectly clean and not laminated, with water on one side and fire on the other, can be burned overheated." When overheating occurs there is some cause for the heat failing to be conveyed to the water, and these causes were various. He thought Mr. Stirling's remarks as to lack of defined circulation in such a boiler were justified, though the overheating from this cause was generally not sufficient to produce such an effect as in this case. He did not think that was the cause of the trouble in this case, because the effect would have been more general and not so localized or defined. Dirt, he thought, was the probable cause, for it will gather at a definite point, the circulation tending to do this, and this point being unfortunately the hottest part of the boiler. He called attention to the marks of erosion near the edges of the ruptured sheets, and said these were made by the escaping steam and water, and would account for the thinness of the sheet at that point. There were also indications of a blister or want of homogeneity of metal, which, by preventing free transmission of heat, helped to produce the thinness by the burning away of the metal, which occurs frequently when the heat is intense. In locomotive boilers, when the sheet exposed to fire was more than $\frac{5}{16}''$ thick it would be burned away to that thickness, and he believed it was a rule in the navy not to allow sheets exposed to fire to be over $\frac{5}{16}''$ thick. He thought there was dirt in this case, which was washed out of the opening, and that the accident was neither peculiar nor uncommon, but was well within the knowledge of boiler makers and engineers, as to its causes.

Professor Denton said it had been determined of late years in marine work that in some cases a scale so thin as to escape the notice of the engineer might easily cause bulging. A scale composed of salts of lime combined with oil, not over $\frac{1}{32}''$ thick, had been shown by investigations made in England to be sufficient to entirely change the conductivity of the plate, and this scale might easily be overlooked, and the boiler called clean.

Mr. Holloway wished to know what would become of a boiler covered with scale $\frac{1}{4}''$ thick.

Mr. Platt thought that the only reason the type of boiler in question had survived in this country was that we had here much purer water than in England, where they were compelled to use boiler water in many cases that would deposit a scale $\frac{1}{4}''$ thick in a few weeks, and he had himself frequently been in boilers that had $1\frac{1}{2}''$ of scale in them; still these boilers do not burst. In the boiler in question, the hottest part is at the bottom, and the dirt goes just there, and he thought the frequency of explosions was due to this. He thought the pressure, 125 pounds, was too high, and that the boiler was good for 60 to 70 pounds. In the Lancashire form of boiler, where they fire in the flues, there seems to be little or no tendency to deposit dirt at the hottest part.

Mr. R. W. Hunt instanced the case of a boiler ordered from a well-known firm of commission merchants by the Louisville & Nashville Railroad. The specifications were very full as to physical and chemical qualities of the steel. The boiler makers, however, required no inspection of the sheets, and the boiler when made was shipped to the Louisville & Nashville Co., who refused to receive it unless satisfied as to the quality of the sheets. The commission merchants, in the commercial view of the case, sent to the inspectors some pieces of steel which they said represented the steel that that firm of steel makers were in the habit of furnishing for boilers, and that they should think that would be all the evidence they would require. This was not satisfactory, but the steel makers, who had acted in perfect good



Section at Point of Rupture.
Fig. 3

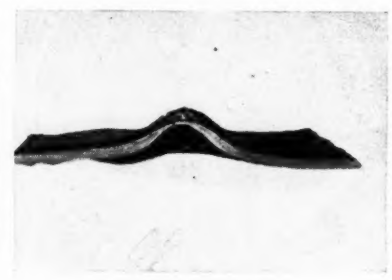


Fig. 4.

Fig. 5.

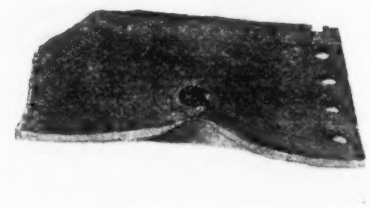


Fig. 6.

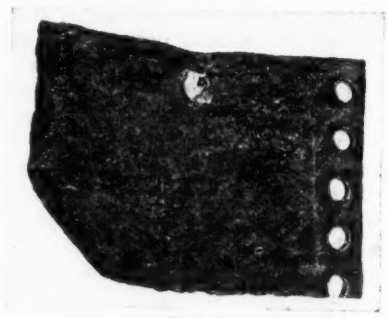


Fig. 7.

Fig. 8.

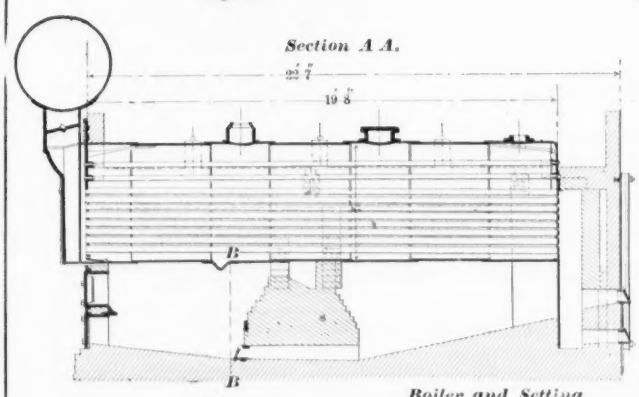


Fig. 1 *Boiler and Setting Washburn & Moen Manufacturing Co.* *Fig. 2*

American Machinist

faith, submitted tests from the same heat from which these plates were made. They fell inside the physical requirements, bu were away outside the chemical; in fact having just twice as much phosphorus as the specifications required. Fortunately, the Railroad Co. refused to take the boiler. In another case a failure resulted from lamination at the edge where the rivet holes were, and the workmen failed to report the condition of the sheets.

Mr. Oberlin Smith thought it might be possible to arrange a pipe within the boiler, terminating in the space just above the bot tom of the shell, and then, by having a stop cock outside, determine whether solid water were there or not under varying conditions of pressure and rapidity of evaporation.

Mr. Manning thought the trouble might have originated from a few drops or globules of oil getting in, and in circulating around the boiler, gathering up such other impurities as might be attracted to it, the whole forming a mass of stuff which finally settled down over the hottest part of the sheet, and kept the water away from contact with it. He knew that in this works they had formerly been troubled with sewage contamination in their boiler water, and would be interested in knowing whether or not there was still a possibility of this. He thought, however, that the type of the boiler was faulty; that an externally fired boiler was wrong to begin with, and that its position was wrong; it ought to be turned up on end.

Mr. Babcock said, in answer to the question as to what became of boilers with scale 1½" thick, that they burned out if the scale was over the hottest part of them, but usually it was not. There was also a great difference in the character of scale—some scales an inch thick would not keep water away from the sheets as much as other scales ⅛" thick. This was due to differences in porosity of the scale. Speaking of experiments, he said he knew of a case where a boiler (full of tubes) had been turned up on end as Mr. Manning had suggested, and a fire built inside. It was a very tall boiler, and the water level had been known to vary four to six feet. There was every reason to believe that, when the water was at the highest point, there was a good deal of steam below it, and he did not think any further experiments were needed to show that under some circumstances the water did not remain in contact with the sheets. Nevertheless he believed that in the case under discussion there was a localization of dirt.

Mr. C. A. Hague thought the discussion was taking the form of a sparring match between the water tube and the other boiler makers, and he was glad of it, because each would probably expose the weak points of the other, and the outsiders would get the benefit of it. He thought dirt and oil caused the trouble.

Mr. Stirling thought the type of boiler was very good, so long as you did not try to make too much steam, or carry too high pressure.

Mr. Kafer said, in part, "If you get a scale ¼" or ⅛" thick over the crown sheet, and burn coal at the rate of 40 or 50 pounds per square foot of grate, you will have some trouble. If you burn 10 or 5 pounds the case is different."

Mr. J. G. Winship mentioned a feed-water heater which, for a time, was quite popular some years ago, until people using it found they had sagging of their boilers, as in this case. This was found to result from the fact that the heater carried the oil from the engine into the boilers.

Mr. Cartwright did not take much stock in the oil theory, because oil, being lighter than water, would not go to the bottom. There was a physical defect in the sheet, and inspection would not always show such defects. This was well understood in forging. In a puddling shop he had seen a 4" square bar faggoted, and when the shaft broke this bar was easily pulled out from the center of the shaft with a pair of tongs, owing to the fact that the magnetic oxide did not allow a union.

Prof. Denton said, "I want to mention that oil, as shown by Prof. Lewis' experiments, is able to sink by joining itself with the carbonated sulphate of lime, and when that scale at the bottom of the boiler is analyzed it is found to be 25 per cent. oil."

Name Plates and Register Letters.

Register letters are cast upon work to enable purchasers to order parts to replace broken and worn castings, without the trouble of specifying dimensions. Manufacturers' names and addresses are cast directly upon work, either as separate plates, or are screwed upon it as perpetual advertisements. I propose in this paper to consider these matters from the point of view of the pattern maker.

The simplest and commonest method of casting letters on patterns is this: Quantities of letters of various sizes, say from ¼" up to 3½" or 4" in length are kept in stock in the pattern stores, and from these such are selected as may be required, and are arranged and fastened upon the pattern. A few words on these two matters will be desirable. First as to the shapes and materials of these standard letters, and second as to the methods of securing them to the pattern faces.

Fig. 1

As to their shapes, the most severe simplicity is always best from every point of view, and the more so the smaller the size of the letters. Almost invariably the block form of letter, Fig. 1, *E* (left hand) should be selected in preference to any other type, for these reasons: There is less time occupied in first cutting the pattern, in filing the letters themselves, and in molding them, the latter being, however, the most important reason of all. A comparison of the three letters in Fig. 1 will illustrate the truth of this statement. Any one who knows anything of molding will recognize the greater difficulty of preserving the little bits of sand intact at *a a* in the second and third letters, by comparison with the corresponding parts in the first letter. And in molding pattern letters there should be, if possible, no mending up done; certainly all needless work should be avoided, because it is almost impossible to mend up such molds as cleanly as those of larger size can be done. The only way available is to take a single pattern letter and put it into the impression of the broken letter, and so make it good, and thus with all broken letters in detail. So that, as regards type of letter, I should say use the block form invariably, for all sizes under 2" or 2½"; above those sizes the other types shown in Fig. 1 may be employed if thought desirable.

Fig. 2

The sectional form of the letters is also of prime importance. The taper of letters must always be very greatly in excess of that usually given to patterns. Fig. 1, *b*, shows the amount of taper that should be given to pattern letters. The reason is clear enough when we consider the awkward little bits of sand that occur in such molds. Take such letters as A, X, V, M, K, N, Z, for example. At a glance we see that there are keen angles of sand that are very easily broken down, and that will certainly break down if only a moderate amount of taper is imparted to the letters.

Fig. 3

The relative lengths of letters differ. In Fig. 2 they are long and narrow, in Fig. 3 they are relatively broad. There is an advantage in using the former where dimensions are contracted, because more can be got into a given length.

The materials used for letters are lead, tin and brass. The only recommendation of lead letters is their cheapness. The objection is their softness, rendering them so easily liable to distortion. Tin letters are rigid, but are as costly as brass. For good work the latter are the cheapest in the long run. They are easily filed, retain their form, and are practically everlasting. It would be always truest economy to melt up all the lead letters in a shop, the accumulation of years, and prepare once for all a sufficient stock of brass letters of all sizes.

In letters of large size, say of over an inch in length, the weight of brass becomes a consideration. The practice then is to lighten them underneath, Fig. 1, *D*, which shows the back of a letter, and its section. A bridge of metal only is left at the spots where the holes are drilled for the pins by which the letters are tacked on the plate. Even if the letters were cemented only, this hollowing out in no wise interferes with their adhesion to the plate, and it saves nearly half the weight of metal.

Methods of securing letters to plates are cementing and nailing. Neither are very satisfactory methods. The cement used in pattern shops is thick shellac varnish, sometimes thickened with powdered chalk; the nails are tiny brass or iron nails, similar to those used by upholsterers. A blow is apt to detach cemented letters, and also to loosen those which are nailed on. And name plates are often prepared in haste, so that there is scarcely time for the cement to dry before the pattern has to go into the foundry sand, and then the letters will become detached during molding. Name plates are made so thin that there is scarcely wood enough to give sufficient hold for the nails, so that while some are being fastened on others become loosened. Further, the constant driving of nails into lead pattern letters, and their removal and refixing on successive name plates distorts those letters in the course of time. Nevertheless these are evils inseparable from the incessant alterations to which name plates are subject for jobbing work; but better methods are available for standard work, the name plates for which are not altered, except in the matter of date, and for register letters cast upon patterns.

Fig. 4

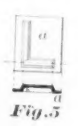


Fig. 5

Fig. 6

The usual method of making a pattern of a name plate is as follows: The plate itself, Figs. 2 and 3, is made of thin wood, filleted round the edges. Its thickness will range from ⅛", or even less, to ¼" or more, dependent upon area. The fillets are glued or nailed upon the plate. Parallel lines are marked as guides for putting the letters on by. In standard plates the letters should be securely cemented, and in the thicker plates nailed also. Previous to cementing, the grain on the surface of the plate should be filled in with two or three applications of shellac varnish, and glass papered down. Otherwise the varnish which is applied to stick the letters will mostly become absorbed into the open grain of the wood and fail to hold.

The letters are then cemented on, but are not nailed until they are dry. The reason is that nailing at once would start some of the letters out of their places, whereas if left until dry they can be nailed with safety. Moreover, when the letters are being cemented, before they are quite set firmly, minute adjustments for position can be made, which cannot be made properly after they are nailed, and those minute adjustments make a deal of difference in their regularity of appearance. A trained eye is a better guide for setting and adjusting letters than straight edges and rule. If letters are well cemented there is little or no need to nail them as well; but they may be safely nailed when the varnish has set hard. Finally a last coat of varnish over the letters, and well worked round them, will form an extra bond of attachment between them and the plate, filling in the angles formed by the contact of their edges with the plates. By this method a good and fairly permanent job can be made, and the plate will stand one or two dozen moldings without injury.

If a pattern for more permanent use is required, then it must be made entirely in metal, generally in iron or brass, molded from a wood pattern, and well filed up, particular care being given to the edges of the letters. If made of iron the pattern will be rusted and varnished, if of brass, simply brushed over with a black lead brush, to facilitate delivery from the sand.

It frequently happens that name plates have to be curved to fit round similarly curved portions of engine and machine framings. Then, if intended to be made in iron, a flat wooden pattern is first constructed in the ordinary way. A temporary leaden pattern is molded from this and is bent to the required curvature, and laid, and its face rammed upon a block of wood, also curved similarly, to prevent distortion of the lead pattern during molding. A curved iron pattern is then cast from this. This is the permanent pattern, from which, when filed up, the actual curved iron name plates are molded.

If, however, the name plate is to be of brass, it is cast from a flat pattern in soft yellow metal, which is capable of being bent without cracking.

In the case of a standard metal pattern which requires a slight alteration from time to time in the date of the year, or in consecutive patent numbers, there are two courses open. One is to leave that part of the plate destitute of figures, and cement on whatever figures are required. Thick shellac varnish will hold tolerably well on metal for one molding. The other method is to cut a tapered hole in that part of the plate, and insert a loose bit with the required number on (see Fig. 4). The upper part of the figure shows the open hole in the plate; the lower part shows it filled up with its temporary number for casting.

In reference to register letters cast upon separate pieces of work to serve for their identification, the method of fastening on individual letters is not a good one. The molders are not always particular about removing these letters from patterns for mending up, and apart from this the letters are apt to become moved out of position, and to stand anyhow but regularly. For register letters the following are better methods:

First, use letters stamped in sheet metal. These, Fig. 5, are not so liable to become shifted out of place as the ordinary letters are, because the edges of the sheet *a*, in which each letter is stamped, is cut to a definite rectangular outline, by which mutual support is given to the edges of contiguous letters.

Second, and I consider this the better plan, each register number is cast upon a single plate from a wooden pattern, and the plate is let into the wooden pattern and screwed in place (Fig. 6). The letters in this case must always retain the same relation to one another, and the only effect of rough usage could be to detach the entire plate, which would, of course, be at once observed and put right.

I. H.

A Great Ship Canal Project.

A Duluth (Minn.) dispatch says: Secretary Thompson, of the local Chamber of Commerce, has prepared his letter calling for a convention to consider the construction of a ship canal through American territory from the Great Lakes to the Hudson River, and thus to the sea. In it he calls attention to the importance of the proposed waterway as an essential portion of national defenses, and says: "Inside of five years Canada will have a waterway fourteen feet deep through her own territory, all the way from Lake Superior to the sea. Her vessels and her commerce can then go unhindered out from the heart of the continent over all oceans to the markets of the world, while there are more than 150 war ships in the English navy which a depth of fourteen feet would suffice to bring into the lakes from the sea." Mr. Thompson proposes that a convention be held, soon after the Christmas holidays, in Washington, so that the attention of congress may be called to the necessity for immediate action.

The new East River Bridge Co. has been granted the right, so far as New York is concerned, to build a bridge between New York and Brooklyn.

LETTERS FROM PRACTICAL MEN.

A Frank Criticism.

Editor American Machinist:

As an old subscriber to your valuable paper, I would suggest that such articles as that written by Mr. Arthur would be better left out of the AMERICAN MACHINIST—such subjects cannot fail to create ill-feeling.

As you say in another part of your issue, "It will no doubt bring upon us the charge of encouraging American boasting"; perhaps it will, but for my part I think it ought to be ignored, as it deserves.

I am not a "locomotive man," and therefore do not know whether an American locomotive is better than an English locomotive; but they have built locomotives in England for a good many years now, and I suppose they build them to suit themselves, the same as they do here. But as to English marine work, it speaks for itself, and I *do* know a little about that.

Any one who goes to England, or anywhere else, with the intention of finding fault can easily find it, and it seems to me that Mr. Arthur went to England to find it, and found it.

There are a good many Englishmen (or, rather, Britishers) in America, and a good many of them are subscribers to your paper, which is considered the best of its kind, and in justice to them and many more sensible people, the waste-paper basket would be the most fitting place for such stuff.

Chicago, Ill. GEO. M. DOUGLASS.

Notes on Rope Driving—A Correction.

Editor American Machinist:

Kindly allow me space to point out a slip which occurs in the center of the fifth column of my contribution, "Notes on Rope Driving" (Nov. 10th issue). The value of t_0 is given as $60 + 81$ pounds, but it should be $43.8 + 81 = 124.8$ pounds; that is, 20 per cent. of 219 pounds plus the centrifugal tension. The apparent mean normal pressure then becomes 11.8 pounds and the *net* mean normal pressure 7.3 pounds, instead of 7.75 pounds. M. E.

Manchester, Eng, Nov. 17th.

Making a Key Wrench.

Editor American Machinist:

I beg leave to offer what I think a better way to make a chuck key than that given to "Amateur," in Query 511. Use a piece of square steel of suitable size, and drill a hole into one end of it equal in diameter to the diagonal diameter of the set screw or chuck-screw on which it is to be used. Get ready a piece of square steel of right size to fit the hole when finished, and a few inches in length. Take a heat on the end of the blank and carefully hammer it on the corners till it is approximately round, and the driving in of the steel of the four corners will make the hole approximately square. Now drive in the piece of steel prepared for that purpose, and close the hole down a little, and it is ready to put into the lathe to finish. The writer made a good one in this way this morning. T. H.

[This method may be considered to be that referred to in the answer where forging such a wrench is spoken of.—ED]

That Chinese Ball.

Editor American Machinist:

Noticing the article in this week's number, signed "A Mechanic," and referring to the letter of Prof. Sweet on Chinese Puzzles, I gave the ball, having brought them from China, and was present when the ball was cut in two pieces to see what kind of a trick the thing was. Instead of the coil bell being alone in the ball, there is another small piece of square steel that is loose, and as you shake the ball this small piece of steel strikes the screw shaped bell, and makes the sound. I have several of them at present, and think if "Mechanic" could see the facilities that the Chinese blacksmith makes this ball with, and the cost of them there, all polished nicely, he would never attempt to make one; in fact, I doubt if they can be made in this country; possibly by the aid of electricity they might be made, but I think it would be cheaper to buy them from China, at the cost of 15 or 20 cents.

HARRY COMSTOCK.

Experience with Engine Bearings.

Editor American Machinist:

Under the above heading in the AMERICAN MACHINIST of June 16th, I contributed a note on the subject, to which Mr. Booth kindly responded, offering a possible explanation of the case. This explanation does not cover the case as well as it does the one he gives an illustration of, for the bearing he shows has a brass box in it; and, as brass is a better heat conductor than the iron which incloses it, there will naturally be a more rapid expansion and consequent pinching of the journal. The bearing I discussed was babbitt-lined, and the cap was of the same material as the engine frame which formed the other half of the bearing. This being so, we might reasonably expect the one to expand as much as the other, and there would then be no consequent cramping of the cap or any change in shape of the bearing caused by a change of temperature. Examination of caps after being in use different periods of time showed that they did change shape, and the evidence indicated that the cap expanded more than the other part of the bearing. The only cause for this that now seems probable to me is that, as the frame of the engine is a large body of metal and is only affected by the temperature in one place, the part that is not heated forcibly prevents the part of the frame forming the bearing from expanding as the cap does, and as a consequence the cap cramps the journal.

C. O. Sine gives some interesting experience with an engine crank-pin bearing, in Sept. 15th AMERICAN MACHINIST, and this calls to mind a peculiar experience I had with one.

The engine was a single-valve, automatic 14″ x 24″, with a piston valve, and of the center crank style. The governor in a wheel on the crankshaft was one that had been invented and used but a short time, and this engine had been running with satisfaction for several weeks when they began to have trouble with heating of the crank brasses. The brasses were taken out and re-fitted and better oiling arrangements applied, but all without apparent effect. I then had the brasses lined with the best babbitt metal and tried again, but with no better results. By this time I thought I ought to look into the other end of the engine, and I therefore applied an indicator and discovered that one end of the cylinder was doing all the work. Looking into the governor to see what caused this, I found that the man who designed the governor did not know much about wheel governors, for the arrangement was such that the eccentric and both governor levers with their weights were entirely unbalanced against gravitation, and the eccentric dropped at each revolution and prevented steam admission at one end of the cylinder. I rigged up a temporary balancing device by pivoting a lever to the engine room ceiling and attaching one end to the eccentric yoke, and to the other end hanging a weight sufficient to counterweight the unbalanced portion of the governor, so that the indicator showed a proper steam distribution. No further trouble was experienced with heating of the crank-pin; and this brings us to the point of interest in the affair, and that is, that the crank-pin was doing the same amount of work as before the change, and yet it did not heat. The reason for this is the same as for the crankshaft of beam engines mentioned by Mr. Booth. Each half of the crank-pin brass is relieved of pressure during a stroke of the engine, and thus gets lubricated thoroughly for the next stroke; but when the cylinder was taking all the steam at one end the crank brass was held continuously against the pin, and thus was heated. Were it not for this favorable condition, crank-pin bearings would need to be four times as large as now made. I have never met with quite so puzzling a case of trouble with a crank pin as that mentioned by C. O. Sine, but I know that brass is a material that has not a very high limit of efficiency for bearings, and has about gone out of use for crank-pin bearings on engines run at modern speeds and pressures. I have now in mind an engine 36″ x 48″ at 70 rev., with a throttling governor, supplied with steam at 110 pounds boiler pressure, which operates a mill, of which one portion is not operated continuously, and when the whole load is on the crank brasses always heat, but cease as soon as that part of the mill is thrown off. A new pair of brasses are being made, lined with babbitt, and I will await the result with interest. I think that success will more often follow where babbitt is substituted for brass than where brass is substituted for babbitt, and there is one thing that will cause the failure of a babbitted bearing which will not have a like effect on brass. In very many locations engines are situated in a dusty, dirty place, and are oiled with an indifferent sort of oil, and considerable fine grit gets worked into the bearing in course of time, and as babbitt is a soft material this grit beds itself in the bearing until it forms a sort of grinding pad which spoils the fine wearing surface of the journal, and ultimately may cause heating. In such a case re lining the bearing with clean babbitt is all that is required to prevent heating, and I would inquire if C. O. Sine has always tried that before substituting brass. As to the "sandwiching" the two metals, there are other reasons for it than that mentioned by C. O. Sine. Brass is a good conductor and will dissipate the heat from a journal rapidly. It is also convenient to babbitt and —— up, and does not wear grooves in the shaft like cast-iron would. BELL CRANK.

A Review of Fly-wheel Formulæ—III.

BY PROFESSOR JOSEPH TORREY.

The two classes of fly wheel formulæ thus far considered mark, as it seems to the writer, successive stages in the development of the subject. Each step has brought us a little nearer first principles. It remains now to consider the work of those writers who regard the proportioning of a fly-wheel as simply a question of matter and motion, depending on elementary every-day principles.

One of the earliest to attack engineering problems mathematically was Moseley. In his work on 'The Mechanics of Engineering," pp. 353–363, he devotes considerable space to the consideration of fly-wheel action. The question is very thoroughly discussed for connecting rods of different lengths, single, double and triple crank engines for heavy and light work, and the results are finally brought down into working formulæ which are simple and easy to use. The methods are those of elementary mechanics aided by mathematical analysis. All that must be remembered while using his results is that the work was done in days when close regulation, as we think of it now, was not in sight at all, but the formulæ being founded on first principles, and the constants being significant and not arbitrary, it is easy to change the value of these significant constants to accord with modern practice. It is worthy of notice, however, that although Moseley very clearly states, in another part of his book, that the rotative effect is irregular throughout the stroke, and that this irregularity results in an irregular fly-wheel motion unless it is corrected in some way, he does not, so far as I can see, take this fact into account in his treatment of the subject. This circumstance detracts, in my opinion, from the usefulness of his final formulæ. I will now give his results:

If W = weight of fly-wheel rim *in tons*,
R = the mean radius in feet of the rim,
K = sectional area of rim in square inches,
H = horse-power,
n = denominator of fraction by which the velocity is to be allowed to vary from the main velocity,
N = number of *strokes* per minute,

then for single-acting engines, *i. e.*, where the steam acts on only one side of the piston, we have the following formulæ for the weight, mean radius, and sectional area in square inches of a fly-wheel rim under the proposed conditions, namely, that the velocity is to be allowed to vary by only $\frac{1}{n}$ of the average velocity:

$$W = \frac{95{,}330.64\, H\, n}{N^3\, R^2}.$$

$$R = \frac{42.27}{N}\sqrt[3]{\frac{H\, n}{K}}.$$

$$K = \frac{75{,}524\, H n}{R^3\, N^3}.$$

For double-acting engines we have

$$W = 18{,}207\, \frac{H\, n}{N^3\, R^2}.$$

$$R = \frac{24.3593}{N}\sqrt[3]{\frac{H\, n}{K}}.$$

$$K = 14.424\, \frac{H\, n}{N^3\, R^2}.$$

Finally for double crank engines

$$W = 9{,}103.5\, \frac{H\, n}{N^3\, R^2}.$$

$$R = 19.3339\sqrt[3]{\frac{H\, n}{K}}.$$

$$K = 7{,}212\, \frac{H\, n}{N^3\, R^3}.$$

The "horse power" should be that indicated when cutting off at ¼ stroke, which is the ordinary standard rating. The rim is supposed to be made of cast-iron of average quality, the weight of one cubic foot of the same being taken as 450 pounds.

Morin treats the subject of fly-wheels in his "Mechanics" (translated by Bennett in 1860), p. 250, and also in his "Mécanique Pratique" (1871), pp. 310–321. His analysis of the matter is easier reading than Mosley's work, as he makes use of very simple forms of calculation. In the English translation the reasoning by which we arrive at clear ideas of fly-wheel action is so plainly and comprehensively stated that I shall take this opportunity of presenting it, with the addition of such comments as will make it easy reading for any one acquainted with arithmetic and algebra.

It has been shown that the rotative effect exerted on the crank-pin is irregular; it follows, then, that the motion of the crank-pin in its circular path will tend to be also irregular, and, moreover, irregular in the same proportion as the effort is irregular. Let us represent the average or *mean* velocity in feet per second of the fly-wheel rim by V. Now at the point where rotative effect is at its greatest, this average velocity will be increased by a small amount. Let us call the resulting increased velocity V_1. Again, when the rotative effect is at its lowest the wheel velocity will be reduced by a small amount and become say V_{11}.

The moving energy of the wheel rim at velocity V_1 is $\frac{1}{2}\, M\, V_1^2$. At velocity V_{11} it is $\frac{1}{2}\, M\, V_{11}^2$, where M = the *mass* of the rim. If we wish to use the *weight* instead of the mass we must substitute for M, $\frac{W}{g}$ where W is the weight in pounds and g is the acceleration of gravity.

Now the difference between the moving energy at velocity V_1 and at velocity V_{11} is

$$\frac{W\, V_1^2}{2\, g} - \frac{W\, V_{11}^2}{2\, g}, \text{ which equals}$$

$$\frac{W}{2\, g}\,(V_1^2 - V_{11}^2).$$

This is called the "fluctuation of energy." This amount by which the energy of the wheel varies will be some per cent. or other of the *average* energy which is stored in the wheel at the average velocity V. That is, the energy of motion of the wheel will reach a highest value at one velocity, and a lowest value at another. The difference between these two values will be perhaps 25 per cent. or some other per cent. of the average energy the wheel gives out. Let us call this per cent. c. Then we shall have

$$\frac{W}{2\, g}\,(V_1^2 - V_{11}^2) = c\, E,$$

where E is the average energy of motion of the wheel at average velocity.

Now we will analyze this expression. From algebra:

$$\frac{(V_1^2 - V_{11}^2)}{2} = \frac{(V_1 + V_{11})\,(V_1 - V_{11})}{2}$$

Now we can put our expression in this shape:

$$W\,(V_1 - V_{11}).\ \frac{V_1 + V_{11}}{2} = c\, E.$$

Once more, we see that $\frac{V_1 + V_{11}}{2} = V$; that is, if we add together the greatest and least velocities, and divide by 2, we get the average velocity very nearly. This is a valuable point. Now let us impose one more condition: let us specify that the difference between the greatest and least velocities of the wheel rim shall be only a very small decimal fraction, say .02 of the average velocity. If, now, our wheel is proportioned on that plan, we shall have $(V_1 - V_{11}) = m\,V$, where m is the small decimal fraction. Now, remembering these two new wrinkles—that $\frac{V_1 + V_{11}}{2} = V$, and that $(V_1 - V_{11})$ is to equal $m\,V$, let us ring one more change on our expression for the fluctuation of energy. Substituting, then, these values in their places, we have:

$$\frac{W\,m\,V^2}{g} = c\,E.$$

This is our equation of condition; that is, if we have proportioned our wheel according to the principles we have laid down, so far, this equation must be true. Now by solving the equation for W we shall obtain immediately a formula by which we can calculate the weight required under our specified conditions; and, solving, we find:

$$W = \frac{c\,E\,g}{m\,V^2}.$$

E = total average rotative effect per revolution,
c = a small decimal fraction,
g = acceleration of gravity,
m = decimal fraction by which the velocity is allowed to vary,
V = average velocity of rim in feet per second.

This is the backbone of all true fly-wheel formulæ. It takes account of *all* conditions, and will fit any case. Of course, it only applies to a single-crank engine. The case of two and three cranks will be considered later. As I showed in a previous paper, Morin made many attempts to determine values of c which could be used arbitrarily, but the attempt bore no fruit which modern engineering can use. For each separate type of engine it must be specially determined. For instance, I have examined many cards from Armington & Sims engines, and worked up values for c from each case. At the same points of cut-off they agree very closely indeed, so I think that if the value of c were once carefully determined for the standard Armington & Sims engine, this value could be used on any engine of that type, no matter what size. I have examined other engines in the same way, and the result confirms my belief. The method of working up cards for c was given by me in the AMERICAN MACHINIST for August 20, 1891, and I shall have occasion to refer to it later at more length. I have also shown, in the paper preceding this one, that the value of m is not clearly defined in engineering works. It cannot be calculated as c can—it is a matter of judgment. In the formula I have just given, it is virtually a per cent. expressed decimally, and if m is taken as one per cent. = .01, that is, if the speed is only to vary one per cent., this will be as steady motion as modern practice requires (for electric lighting, for instance). Generally, engines are built on fixed patterns. It is expensive business changing flasks, and wheels are usually made in only one or two standard sizes. A good average value for m would lie between .015 and .025. For most purposes .025 would do very well. We will try later on and see if we can find what practice modern builders follow.

The reasoning by which we arrived at the formula was substantially that of Morin, but is rather more closely related to that given by Cotterill in his "Applied Mechanics" (published in 1884), p 231. It is to be found somewhat modified, according to the peculiarity of style of the separate witers, in a number of other works on the steam engine. Rankine gives practically the same reasoning in his work on the "Steam Engine," p 60, and also in his "Applied Mechanics," p 623. Ewing, in the "Encyclopedia Britannica," in the article on the steam engine, gives the same, and, in fact, wherever the subject is taken up as a question of mechanics and mathematics the reasoning is always practically the same.

Morin gives, as based on his reasoning, the following formulæ without explanation as to the value of the constants.

For expansion engines:

Cutting off at ½ stroke $W = \frac{168{,}089\ H.\ P.\ n}{m\ V^3}$

Cutting off at ⅓ stroke $W = \frac{193{,}864\ H.\ P.\ n}{m\ V^3}$

Cutting off at ¼ stroke $W = \frac{218{,}849\ H.\ P.\ n}{m\ V^3}$

For rolling-mill engines (from observation):

$$W = \frac{3{,}086{,}258\ H.\ P.\ k}{m\ V^3}$$

$H.\ P.$ = nominal horse-power,
m = number turns of wheel per minute,
V = mean velocity of wheel rim in feet per minute,
W = weight of wheel rim in pounds,
k = constant number,
n = constant number.

Morin states that this constant k may be taken as—

20 for engines of 80 to 100 horse-power and with 6 or 8 equipments of cylinders;
25 for engines of 60 horse-power and having 4 or 6 cylinders;
80 for engines of 30 to 40 horse-power with one or two cylinders.

An interesting fact in this connection is that Morin takes the opportunity to compare the results of his formulæ with the practice of contemporary engineers. It appears from these comparisons that if n be taken as 32 (or about three per cent.), according to Watt's practice, the results calculated agree very closely with successful practice. Considerable data is also given concerning fly-wheels working against a variable resistance; but this point must be reserved for another paper.

World's Columbian Exposition.

The Worthington Pump Company have begun the erection of their fifteen-million-gallon pump for the pumping station. This pump is a duplex tandem compound vertical 30 and 60-inch steam cylinder, 32-inch plunger, all by 60-inch stroke. It stands 49 feet 3 inches above the top of its foundation, and 39 feet 6 inches above the main floor of the pumping station. The base plate is only 23 feet by 10 feet. The largest casting weighs about 37,000 pounds, and the entire machine about *400 tons*.

For the purpose of erecting this pump the Worthington people have found it necessary to construct in the pumping station a temporary traveling crane, the runways of which are supported from the ground on huge timbers.

The pump above referred to constitutes one of the four pumps furnished by the Worthington Company for the Exposition pumping plant. The plant will contain six pumps, located in an independent building near the southeast corner of Machinery Hall, directly opposite the boiler house. Besides the pump above referred to there will be a compound duplex horizontal with high-duty attachment, 25 and 50x27½x36, 12½ million gallons capacity in twenty-four hours; a triple expansion horizontal high-speed pump, 6 and 9½ and 15x9½x48, 5 million gallons capacity; a 4 cylinder triple expansion vertical beam engine, 15 and 33⅝, 7½ by 36", 7½ million gallons. These four pumps, with a total capacity of 40 million gallons per 24 hours, comprise the equipment which will furnish water for the fountains and cascade, and in case of fire their capacity will be turned into the mains. The service supply is, however, in ordinary cases, had from the city pumping works.

Besides the pumps above mentioned, the station will contain two small high-pressure pumps which will furnish water to a special system for fire protection to the tall buildings.

These six pumps, together with their condensers, are all furnished by the Worthington Company and installed in the station free of cost to the Exposition Company, the latter, however, building all foundations, and making all piping connections, both steam and hydraulic.

The 12½-million-gallon pump is erected in place and is being connected up. It will take about ten weeks to erect the big one, and the others will follow rapidly.

Jackson Park, Chicago, Dec. 1, 1892.

Society of Naval Architects and Marine Engineers.

Some of the most prominent and influential men in the shipbuilding and shipping interests of the United States have completed the preliminary organization of a professional society of high standing, to be called the "*Society of Naval Architects and Marine Engineers*," whose object will be the promotion of shipbuilding, commercial and naval; and in furtherance of this object annual meetings will be held for the reading and discussion of appropriate papers, and interchange of professional ideas, thus making it possible to combine the results of experience and research on the part of shipbuilders, marine engineers, naval officers, yachtsmen, and those skilled in producing material from which ships are built and equipped.

A society of this character cannot fail to have a great influence on the advancement of shipbuilding in all its branches; indeed, it is reasonable to form such a conclusion when we consider the great amount of good that has been done by similar societies existing in England, Scotland, France, and other European countries. These foreign societies include among their officers and members the foremost shipbuilders, engineers, ship owners, naval officers, members of parliament, and other public men interested in shipping. Many laws promoting the greater security of life at sea, and general improvement in ocean carriers, were originated by these societies, and the present advanced state in naval architecture and marine engineering is directly traceable to their proceedings and investigations.

In this country, the influence of kindred societies, such as the American Society of Mechanical Engineers, Society of Civil Engineers, etc., has done much towards the advancement of knowledge and the successful solution of many knotty problems which have presented themselves in every day practice in these particular branches.

Considering our vast seacoast and magnificent harbors, and the abundance of material from which ships are built, in connection with the increasing importance of our ship building interests and the development of the navy, the organization of this society at this time must be regarded as opportune, and as one that will have a valuable and extended field of influence in technical subjects and public affairs, and it will undoubtedly stimulate actual growth by rousing popular as well as professional interest in a branch of industry which should be one of the most powerful factors in the development as a nation.

We append a list of gentlemen who have accepted offices in the preliminary organization, and who have expressed themselves in most cordial terms as to the expediency and ultimate success of the undertaking: President, Clement A. Griscom, of Philadelphia, president International Navigation Co.; first vice-president, Theodore D. Wilson, of Washington, D. C., Chief Constructor, United States Navy; vice-presidents, Charles H. Cramp, of Philadelphia, Pa., president Wm. Cramp & Sons' Ship and Engine Building Co.; Commodore W. Melville, of Washington, D. C., Engineer-in-Chief, U. S. Navy; George W. Quintard, of New York, president Quintard Iron Works; Irving M. Scott, of San Francisco, vice-president and General Manager Union Iron Works; Francis Walker, of Boston, Mass., president Massachusetts Institute of Technology; William H. Webb, of New York, Naval Architect. The list of members of council also contains names of many prominent men.

It is proposed to have a meeting of the council in January, 1893, at which time all details as to organization, constitution, incorporation, etc., will be definitely arranged, and the exact date of the first general meeting decided upon. It is probable that this meeting will take place in New York at the time of the naval review, in May, 1893.

We wish the society a complete success in its permanent organization and its future usefulness. All who are in sympathy with its objects, and who wish to give it a hearty support and become members, should send at an early date for particulars to W. L. Copps, Esq., Secretary Society Naval Architects and Marine Engineers, 1710 F street, N. W., Washington, D. C.

How Admiral Bailey Related the Story of His Bravery.

Admiral Bailey, of the United States Navy, was a fine example of the delightful combination of great courage and great modesty, according to the *Youth's Companion*. After the capture of New Orleans, during the civil war, he attended a dinner given at the Astor House, and was called upon to reply to the toast of "The Navy." The president of the occasion prefaced the sentiment with a eulogy of the admiral.

As in duty bound, the old sailor straightened himself up for the task.

"Mr. President," he said, "and gentlemen—hem—thank ye."

Then after a lengthy pause, during which he took a fore-and aft survey of the table, he continued:

"Well, I suppose you want to hear about the New Orleans affair?"

"Yes! yes!" echoed through the room, amid the stamping of many feet.

"Well, d'ye see, this was the way of it," resumed the orator, giving a nautical hitch to his trousers, and evidently embarrassed. "We were lying down the river, below the forts, and Farragut he—he signaled us to go in and take 'em. Being as we were already hove short, it didn't take much time to get under way, so that wasn't so much of a job as you seem to think.

"And then the engineers, they ran the ships, so all we had to do was to blaze away when we got up to the forts and take 'em, according to orders. That's just all there was about it."

Thereupon the concise narrator, feeling that he had accomplished everything which had been demanded of him, sat down amid thunders of applause.

Two Engines Run Away.

At 1 o'clock this morning persons walking along Fulton street, Brooklyn, were surprised to see locomotives Nos. 9 and 67 of the elevated railroad, coupled together, dashing along Fulton street at full speed. After running for nearly three blocks the engines dashed into a large bulkhead at the corner of Alabama avenue and Fulton street, smashing it into splinters.

The splinters flew high in the air, and one of the bolts crashed with all force into the big plate glass window of John Moch's liquor store on the corner of Fulton street, breaking it to atoms.

The engines could go no further, and after awhile one of the engineers from the yard at Broadway came up, and, after getting into the cab of one of the runaway engines, brought them back to the yard again. One of them had lost a cowcatcher, and the headlight was badly battered.

How the engines ran away no one seems to know. Both engines were put in the yard shortly before 12 o'clock last night, and after the fireman had raked his fire he left for home. No one was near the engines at the time, and the people about the yard are rather mystified. The only explanation given is that there must have been enough steam pressure left to start the engines in motion.

A Correction.

Mr. John T. Usher calls our attention to a few typographical errors which appeared in his article relating to "Rubber Pattern Work," in our issue of December 1, current volume. In several places the word *cone* is used in place of *core*, and in one instance the word *stone* should read stove.

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The A. S. M. E.

Every friend of American mechanical engineering, and of the society which more than anything else represents it, has cause to rejoice at the success of and the spirit manifested at the recent meeting in this city of the American Society of Mechanical Engineers. The practical unanimity with which the members have retained their membership, notwithstanding the increase in dues, and the uncommonly large increase in membership during the year, notwithstanding the increase in initiation fees, shows plainly the estimation in which the society is held, and demonstrates by the constructive evidence of men who are not apt to act upon false premises in such a matter, that the society is benefiting them in their work, and that it is likely to continue to benefit them. No one who is at all observant can fail to see that the meetings held at the society's house are not only useful, but are thoroughly enjoyed by the members, many of whom meet at no other time, and that they enable them to compare notes—to give and receive helpful suggestions and accounts of experience. This sort of beneficial intercourse is by no means confined to the regular formal sessions, but goes on all the time, and there are many members who derive more benefit from this than from the regular sessions, or from the regular presentation of the papers and discussion upon them.

It is evident, too, that in many respects the society's house in the city is the best place for a meeting. It is nearly as conveniently arranged for the purpose as it is possible to conceive, and its records, its library and other facilities, impossible to provide elsewhere, are at hand, and are made full use of. The nearness of the Engineers' Club adds much to the enjoyment and profit of these meetings, for the club is always hospitably opened for the use of the attending members, many of them availing themselves of the opportunity to get their meals there, and to enjoy its social and other advantages.

The reception at Sherry's is declared by those versed in such matters to have been one of the most brilliant ever held in that habitat of brilliant social functions, and the objects and work of the society and of its members are becoming better understood and appreciated by the general public, all of which tends, of course, to improve the standing of mechanical engineers.

The society has accomplished much good work, and is in a fair way to accomplish much more.

A Successful Operator.

As is well known, we are not among those who believe in the condemnation of men simply because they may have accumulated wealth. Whether wealthy men are to be condemned or praised should depend, not upon the amount of money or wealth they may have secured, but upon their methods of securing it, and the use made of it. Those who have watched and studied closest the recently completed career of Jay Gould, and are best qualified to judge of it, are practically united in declaring that the bulk of his wealth was gained by what were, in all essential respects, gambling operations, in which he used loaded dice and marked cards, and that, for the seventy or more millions of dollars of booty which he secured, he never rendered to the community anything like an adequate return or service of any kind. Many of his operations were those of an anarchist, in which armed forces of men were employed, and it is undoubtedly true that there have been many occasions when he would have been imprisoned for violation of law, had it not been for the magnitude of his operations, and the fact that he was shrewd enough to see to it always that the best obtainable legal talent was employed on his side. His celebrated "compromise" with the Erie road was simply the restitution of some millions of securities, forming a small fraction of what he had previously gained possession of without consideration (which is simply polite language for stealing), and was agreed to by him only because he saw no other way of escaping the penitentiary, and by the officers of the road because they saw no other way of making him disgorge any part of his stealings.

His methods of making a fortune were, in the main, not by the creation of values, but by the interception of the earnings of others.

Many men who work in machine shops, many who carry them on, and are often puzzled to know how to secure a balance on the right side of the ledger at the end of the year's operations, will envy Jay Gould and his great wealth. They need not do so. Jay Gould was simply a skillful and unscrupulous player in a game, and was utterly unable to use one-thousandth part of his winnings for his own comfort and enjoyment, his principal gratification coming probably from the mere gratification of winning and of triumphing over others—a form of gratification which, on a much higher plane, can be had by every one who grapples with and solves problems, the solutions of which are of actual use in the progress of the world—problems which machinists, engineers, and machinery builders are continually attacking and solving.

It is doubtful, however, if Jay Gould or any individual is more to blame for such a career as his than is the community which permits such a career, and which, far too much, worships mere wealth for its own sake, and too much ignores the honors due to honesty, conscientious labor, and usefully employed ability.

During the last few years of Gould's life his operations led him into constructive instead of destructive lines, and he improved some of the roads with which he was connected; but the character of the man was still shown by the fact that at his death what are known as Gould stocks rose in the market—an indication that others considered his death to be the removal of a menace to the properties represented.

Gould's shrewdness also enabled him to see the economy of securing the best possible men, and of paying them enough in wages and salaries to secure their continuous service. Very few men whose services were useful to him were enticed into the service of other interests by increased pay. Good men were worth as much, if not a little more to him, than to any one else, and he let his men know that he recognized that fact, not by talk merely, but by paying them so that there was little or no danger of their being tempted to go elsewhere. This was not by reason of any special regard he may have had for them, nor did charity have anything to do with it; he pursued this course simply because he was shrewd enough to see that it was the course by which most money could be made out of hired services.

He was a successful "operator"—successful simply because he possessed phenomenal ability in certain directions, and never allowed conscientious scruples to stand in the way of what he considered a business operation. He made money, but that is all, and there are thousands of mechanics everywhere who see more real comfort and enjoyment, and who are worth infinitely more to their fellow-beings.

The Pratt & Whitney Co.'s Reorganization.

Considerable interest is being manifested in the reported sale of the Pratt & Whitney shops at Hartford to an English syndicate. We have made some investigation of the matter, and, so far as we are able to ascertain, no English syndicate is interested in the so-called purchase of the business, and, in fact, there has been no sale in the ordinary sense of the word, but simply a reorganization involving a considerable increase of capital stock, which increase is fairly represented by the value of the establishment and the capital required to conduct its business. For years a good part of the earnings of this concern have been devoted to the building of larger shops and the equipment of them This has gone on until the real value of the establishment and the capital required to operate it very much exceeds the capital stock, and the reorganization gives to the old stockholders new and additional stock, representing the dividends they might have received had the earnings been devoted to the paying of dividends instead of to extensions, or, in other words, representing their actual investment. The rest of the stock is on sale in Hartford and New York, and, we presume, may be purchased by any one who wishes to invest in it, regardless of his nationality. The management will, for a definite term of years at least, remain as now, and, so far as we are informed, may continue to be the same for as long a period as would have been the case had the reorganization not taken place.

We are glad to be able to say this, for we must confess that when we heard the first reports that this concern had been absorbed by an English syndicate we experienced something of a shock. The P. & W. shops are so distinctively American, and so much of the history of the wonderful development of American tool building is so intimately connected with them that we should regret exceedingly to see them pass into the hands of any foreign syndicate, and for something more than mere sentimental reasons, too, as our readers know we are opposed to the investment of English capital in American industries for what we consider to be sound economic reasons.

The engineers on the New York Central Railroad are complaining that the road is often so badly blockaded that they are laid up on side tracks for periods of time varying from a few hours to twelve days, during which time they must keep their engines alive in anticipation of a call to proceed. They consider that they ought to receive some compensation for this time which is lost through no fault of theirs—a contention which would seem to be founded in reason, to say the least of it.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(544) J. A. B., Lewistown, Pa., writes: Please tell me where I can rent a lathe 30-inch swing and 20-foot bed, and a planer 30 x30 inches by 8 feet, or as near these sizes as possible; new or second-hand will do. I will pay a reasonable amount for them, and will get them insured and give the party the policy? *A.*—Write to any dealer in new and second-hand tools; the addresses of some of these are given in our advertising columns.

(545) W. H. J., Worcester, Mass., writes: Kindly inform me if there is any country which has offered a premium for perpetual motion. If so, please let me know where I can get particulars and description of machines of this kind. *A.*—We do not believe that any government would place itself in such a ridiculous light before the scientific world as to offer a premium for perpetual motion. To invent such is simply an impossibility. Our advice to you is: Do not seek one, nor attempt to invent one, as such an effort will be only a waste of time, and may involve a great loss of money.

(546) S. R., Elizabeth, N. J., writes: In your answer to Question 527 you say the pressure is 6,165 pounds on each journal. Why is it not half this amount? The shaft is a beam supported at each end. *A.*—That the shaft may be considered as a beam supported at the ends is true, and since the total pressure on the shaft is $6{,}165 \times 2 = 12{,}330$ pounds, the pressure on each journal will be one-half of this total pressure, namely, 6,165 pounds, as we have stated in the answer, which is correct. You have probably overlooked the fact that in transmitting a force of 6,165 pounds there is a pressure of 6,165 pounds on each side of the wheel, making the total pressure on the shaft, and consequently on the two journals, equal to 12,330 pounds.

(547) F. S. W., Denver, Colo., writes: Please answer the following questions through your columns: In crowning the

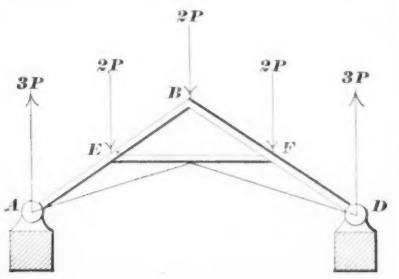
pulleys, what is the rule for finding the proper curve? *A.*—There is no uniformity in practice—even the form of the face varies; some makers adopt a curved face, and others adopt a straight taper from the center to the edge of face, forming two frustums of a cone. The following rule is applicable in nearly all cases: For pulleys having a face wider than 4 inches, the taper each way from the center should be ¼ inch per foot; if curved the convexity should be the same. When the face is less than 4 inches wide, ⅛ to ¼ inch per foot is not too much. 2. What are good proportions for diameter and height of brick chimneys for steam plants, horse-power being known? *A.*—See table of proportions of chimneys, in our issue of April 23, 1887.

(548) V. A. E., Hartford, Conn., writes: Y. and W. have seen a single horizontal engine, the crankshaft of which is not in line with the cylinder and crosshead. W. claims that by this arrangement the dead centers are eliminated, or, in other words, that the engine may be started by steam pressure alone on the piston wheresoever the crank may be placed. Although an experienced engineer corroborated this theory, Y. is not convinced, and hopes you will kindly explain what advantage is gained by placing the horizontal cylinder above or below the level of the crankshaft. *A.*—The cylinder should be placed in line with the crankshaft; there is no advantage in placing it otherwise. W. is all wrong in his theory. The dead centers will not be eliminated, which he would soon find out if he attempted to start the engine from either of its dead centers.

(549) J. M. D, Bonne Terre, Mo., writes: Please give me a sketch and plan for a repair mining machine shop, and suggest which is the best power—electricity, steam, or compressed air. We will have electricity for incandescent lighting, steam to run the works, and air for underground drills. Also what machines would be best-suited to repair air drills, water pumps, jigs for washing ore, and such like—I mean such as lathes, drill presses, and pipe cutters, etc. Also if you would use a circular forge near center of shop, or a forge in the corner, of a rectangular design. How would you arrange the shafting in such a shop? Also give location of work benches. What small tools—such as vises—would be most useful? I am willing to send check of $5 in answer to these questions or other information you may add. *A.*—We always take great pleasure in answering any questions our readers may ask, without any charge; in fact, our invariable rule is never to accept one cent for any assistance we may give; we consider ourselves well repaid if our answers are of any benefit to the readers. But when we are asked to design a whole machine shop, without knowing exactly what work is to be done in it, and run a newspaper besides, we must decline, on the ground that life is too short. You will evidently need a man to take charge of the shop—we should advise you to engage his services as soon as possible, and let him arrange the shop for you, and select such tools as in his judgment may be required.

(550) A. E. C., New York City, writes: Please give us through your columns the best method of dipping rough brass work. *A.*—Copper, brass, bronze, etc., become oxidized in ordinary moist air, and, in consequence of the simultaneous presence of carbonic acid, become gradually converted into carbonates. In fact, the brownish-black to bluish-green deposit, often seen on copper, brass, and bronze goods, is a mixture of oxide and carbonate of copper, mixed with oxygen compounds of zinc or tin respectively when the copper is present as an alloy of these metals. Sulphur compounds are often formed on the surface when the above metals are exposed for some time to the atmosphere in large towns or rooms where coal gas is burned. These films may be removed by immersion in suitable acid dips. For this purpose a series of liquids is used: Pickle or spent aquafortis is very generally employed for a preliminary dip. The articles are allowed to remain in it until the scale of oxide has disappeared, leaving, after rinsing, a uniform metallic luster. Dipping in old aquafortis is recommended for two reasons: it economizes the cost of new acid, and, as its action is slow, it prevents the too rapid corrosion of the cleansed copper during the time of the solution of the protoxide. A dipping liquid consisting of a mixture of 64 parts of commercial sulphuric acid, 32 parts of aquafortis, 1 part of hydrochloric acid, and 64 parts of water, is also used. Other mixtures may be employed for imparting a bright luster to brass, etc.; for these, see "Metal-coloring," by A. H Hiorns—an excellent little book, recently published.

(551) W. S., ——, writes: Kindly inform me which numbers of the AMERICAN MACHINIST contain the series of drawing lessons which were completed about three years ago. *A.*—The series was commenced in our issue of October 23, 1886, and concluded January 2, 1890, and consists of 93 articles. Copies of the AMERICAN MACHINIST containing them can be furnished by us. 2. I would also like to know if the following is correct, taken from Karl Von Ott's Graphic Statics, page 47. "The rafter (see sketch) *A B* is divided in this case into two equal segments *A E* and *E B* at the joint *E*. Suppose the load 2 *P* to act on each segment of the rafter, then *P* will act at the extremity of each segment. Hence on the middle joints *E, B, F*, there acts a load 2 *P* (since these joints are loaded on both sides), but at the extremities *A* and *D* of the rafters there is only the load *P*. Each of the two supports has to supply a reaction equal to half the total load. Each reaction is 4 *P* — *P* = 3 *P*, and this reaction must be considered to act as an exterior force on the adjacent bars." Why is the reaction not 4 *P*? *A.*—The reaction of each support is, of course, equal to 4 *P*, that is, one-half the total load, but the compressive stress in the segments *A E*,



E B, is not due to the whole of the reaction of the support *A*, but it is due, as the author says, to an exterior force acting on the adjacent bars. This force acts upwards in a vertical direction, as indicated by the arrow on the line 3 *P*. The magnitude of this force is found as follows: The load on the segment *A E* is equal to 2 *P*; this load, of course, acts downwards in a vertical line. One half of this load is supported at the joint *A*, the other half at *E*. Therefore at *A* we have a force equal to $\frac{2P}{2} = P$ acting vertically downwards, but the reaction of the support 4 *P* acts vertically upwards, hence we have 4 *P* — *P* = 3 *P* for the exterior force acting at the end of the truss, and it is this force which causes the compressive stress in the bar *A E*. The statement given by the author is correct.

(552) J. R. T., Norwich, Conn., writes: Inclosed I send you a melter's card from the foundry of the Richmond Stove Co., of this city. I would like to know the opinion of Mr Bolland, or some one able to give an opinion in the case. What I want to know is: Can the melting be done in any less time? The iron comes fluid enough, but takes too long a time. I am told that the cupola and blower were intended for but ten tons, but now we want from 14 to 16 tons per day, and have to put the wind on at 2 P. M.

Charges.	Coal.	Coke.	Iron.
Bed.	1,400	100	5,000
1	425	100	4,000
2	425	100	4 000
3	425	100	4,000
4	425	100	4.000
5	325	100	3 000
6	325	100	3,000
7	225	225	3,000
8	100	200	2,000
Total...	4,075	1,125	32,000

The melting is done in a No. 5 Makenzie cupola 40x62 inches inside; fire lighted at 10.30; commenced charging at 11 30; blast on at 2; bottom dropped at 6. *A.*—We referred this question to Mr. S. Bolland, who replies as follows: Your correspondent will find my opinions upon this subject fully represented in the table of instructions for the management of cupolas, published in the AMERICAN MACHINIST, June 30th, 1892; but in order to make said table complete it will be necessary to substitute Mr. Root's corrections for columns containing the list for Root's blowers and horse-power, and which appeared in your journal for July 14th, 1892. The formula of the patentee for a No. 5 Makenzie cupola (40″x62″ inside measurement) is as follows: Fuel on bed, 1,250 pounds; iron on bed, 5 000 pounds, with succeeding charges of 500 fuel to 5,000 pounds of iron; Makenzie pressure blower No. 6, 7 to 8 horse-power; diameter of main blast pipe, 18 inches; to melt 5 tons per hour for two hours, beyond which time they will give no guarantee. From the memorandum sent it is very evident that the instructions of the patentee are not observed in the charging; how far they come short as to blower, size of main blast pipe, power of engine, etc., they do not say. Whether the low rate of melting is due to the non-observance of all the instructions given is, of course, best known to themselves. The 40″x62″ Makenzie would equal a 50″ plain cupola; let your correspondent find 50″ diameter inside of lining in the first column of my table, against which the following full particulars appear: Height, 14 feet; depth of bottom, 10 inches; fuel on bed, 1,470 pounds; first charge of iron, 4,410 pounds; succeeding charges of fuel, 596 pounds; succeeding charges of iron, 5,364 pounds; diameter of main blast pipe, 18 inches; No of tuyeres, 6″ diameter, 8; equivalent in flat tuyeres, 8, 11½″x2½″; blast pressure in ounces, 12; Root blower, No. 4; horse-power for R. B., 12; Sturtevant blower, No. 6; horse-power for S. B., 9¾; melting capacity per hour, 11.790 pounds. Total melting capacity, 47 060 pounds. The results shown must not be expected if every particular is not strictly observed. The fuel used must be coke exclusively if best results are looked for. As charged according to table, the charge sheet for the amount of iron melted would appear thus:

Charges.	Coal.	Coke.	Iron.
Bed.	....	1,470	4,410
1	....	596	5,364
2	....	596	5,364
3	....	596	5,364
4	....	596	5,364
5	....	596	5,364
Total...	....	4,450	31,230

The difference betwixt the present practice and that suggested by the table is therefore as expressed by the following:

Present Rate of Melting Per Hour.	Rate of Melting Per Hour, According to Table.	Present Ratio of Fuel to Iron Melted.	Ratio of Fuel to Iron Melted, as Per Table
4 tons.	5.89 tons.	1 to 6.15 lbs.	1 to 7 01 lbs

Thus making the time occupied in melting 16 tons, 2.71 instead of 4 hours, with a very perceptible saving in fuel.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's New Phila Gear Shop. See page 20.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Ideal Drawing Stands. M. C. Hammett, Troy, N.Y.

Forming Lathes. Mer. Mach. Tool Co., Meriden Ct

$10 Countershafts. A. D Pentz, Elizabeth, N. J.

Tool Holder: Armstrong Bros. Tool Co., Chicago.

New lists of cutters. Brown & Sharpe.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y

"The Bulldozer," a new departure; forging by pressure. M'f'd by Williams, White & Co., Moline, Ill.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Drill Presses, with Tapping Attachments.
Gould & Eberhardt, Newark, N. J.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

S. A. Smith, 23 S. Canal St., Chicago, Ill., is agent for Standard Tool Co.'s Twist Drills.

Pulley lathes, most efficient offered. The Lodge & Shipley Machine Tool Co., Cincinnati, O.

Castings for small and medium-sized vertical engines. Humphrey's Foundry, Bellefontaine, Ohio

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus air pumps, acid blowers, filter press pumps, etc.

"Shapers (Double Triple Quick Stroke")
Trade Mark.
Gould & Eberhardt, Newark, N. J.

For the Latest Improved Diamond Prospecting Drill, address the M. C Bullock Mfg Co., cor. Canal and Washington Sts., Chicago, Ill.

Patterson, Gottfried & Hunter, Limited, 146-150 Centre st., New York, are putting on the market a new alarm speed indicator. Send for circulars.

We electrotype illustrations and advertisements for manufacturers. Prompt and thorough service. Send for estimates. A. Mugford, Hartford, Conn

Gear Cutters, Auto. Specially adapted for Motor Gears and all other style Gears.
Gould & Eberhardt, Newark, N. J.

S. W. Card & Co., Mansfield, Mass., are putting on the market a new line of stocks and dies, with their patent adjustable dies and guide. S. A. Smith, 23 S. Canal Street, Chicago, Ill., Western Agent.

Patent Soliciting of High Class.
D. Walter Brown, Counsel in Patent Cases,
31 Nassau Street, New York.
Send for Brief History of Patent Legislation.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Binders" for the AMERICAN MACHINIST Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

The Development of the Micrometer Caliper.

Having received an inquiry regarding the development of the micrometer caliper, such as is used by machinists and tool makers, we have made some investigation of the matter, and publish below all the correspondence so far received which seems to give real information of value or interest. It explains itself.

Editor American Machinist:

DEAR SIR: We received your favor of the 11th, yesterday, and have hunted up some correspondence in regard to the development of the micrometer caliper and inclose copy of same herewith. The Pratt patent for hardened points referred to now belongs to us, and is dated April 23, 1878. There has been a multitude of other patents taken out, but this appears to us one of the most important. For many years we were the only manufacturers of these calipers, but there are several parties now who make a few. In our 1892 catalogue, a copy of which we mail you, you will find cuts and descriptions of the different varieties of these instruments we manufacture, on pages 163 to 180 inclusive.

We think it would be well to have the information contained in the correspondence inclosed fully set forth in an article in your paper, that it may be referred to in future for any one desiring information concerning this matter. BROWN & SHARPE MFG. CO.
L. SHARPE, Treas.

Bridgeport, Conn., Dec. 8, 1887.

MESS. BROWN & SHARPE, Providence, R. I.

GENTLEMEN: Will you kindly gratify the curiosity of the undersigned relative to the origin of the micrometer caliper as originally made by you. I, of course, know that the principle involved is old, but can you give me the name of the inventor and the approximate date of invention—if it is proper to speak of it as an invention—of the form first made by you? We have with us a man who claims to have first made and used this tool as a sheet metal gauge, that he showed it to Mr. Sharpe, and from that the B. & S. micrometer was developed. How much truth or fiction there is in this, I would deem it a great favor to learn from you. Respectfully,
F. A. STRONG, Asst. Supt.
[THE EATON, COLE & BURNHAM CO.]

Providence, R. I., Dec. 10, 1887.

MR. F. A. STRONG, Asst. Supt. Eaton, Cole & Burnham Co.'s Works, Bridgeport, Conn.

DEAR SIR: Your favor of the 8th inst. is received, and we take pleasure in telling you the history of the micrometer caliper as far as our knowledge extends. Some time in the first seven months of 1867 a man connected with the Bridgeport Brass Co. brough, a gauge here of the size and form of the smallest tool shown on blue-print herewith inclosed [Fig. 1], and desired to have some made. It was invented by some one employed in that establishment, we were told.

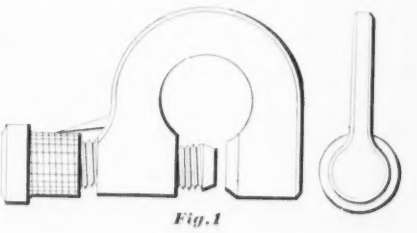


Fig. 1

The reading of thousandths of an inch was done by means of a spiral line of same pitch as the screw, 40 to the inch, running round the cylindrical head of the screw, crossed by 25 lateral lines, dividing this head into 25 equal parts. The pointer which is attached to the body of the instrument shows where the lines intersect, and if you count the number of screw thread lines the pointer has passed over, added to the number of lateral lines, the number of thousandths of an inch the caliper is open can be obtained; but as the cylinder is so completely covered by the crossed lines, rendering it impossible to put any figures upon it, we did not at the time

consider the instrument of practical value, a it could not be easily read. In August, 1867, our Mr. Brown and the writer visited the Paris Exposition and there saw a micrometer caliper like the other tool shown on blueprint [Fig. 2], and brought one home with us. It was at that time well known in France as "Système Palmer," or Palmer's plan of gauge, from the name of the inventor. As a gauge was wanted for measuring sheet metal, we adopted Palmer's plan of division and the Bridgeport man's size of gauge, adding the clamp for tightening the screw and the adjusting screw for compensating the wear of ends of points where the metal is measured, and produced our "Pocket Sheet Metal Gauge," as shown on first page of inclosed circular.

As to whom the credit is due for producing the "Pocket Sheet Metal Gauge," you can determine from the above statement of facts. We never should have made such a gauge as was shown us by the Bridgeport man in 1867 to sell on our own account, as it would be too troublesome to read to be salable. If we had not happened to find the Palmer gauge, and thereby found a practical way to read thousandths of an inch, no gauges would have been made. If we had never seen the Bridgeport device we should have found the Palmer at Paris, and without doubt have made such gauges, but possibly would have made a larger one first. The immediate reason of making the "Pocket Sheet Metal Gauge" was the suggestion coming from the Bridgeport Brass Co., of the want of a gauge of the size of the sample shown us for the use of the brass trade.

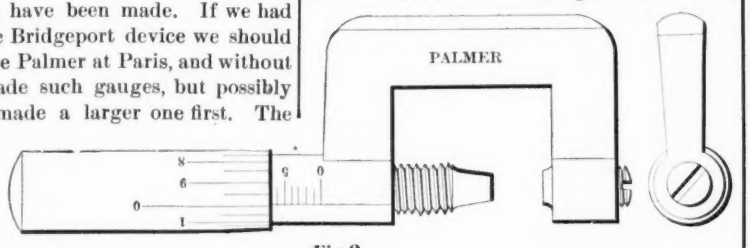


Fig.2

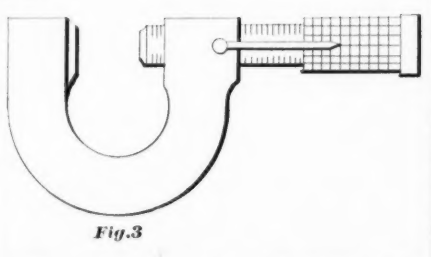


Fig.3

Beside the micrometer shown in circular, we shall soon have one to measure ½ inch and another 2 inch. Yours truly,

BROWN & SHARPE MFG. CO.
L. SHARPE, Treas.

Bridgeport, Conn., Dec. 21, 1887.

MR. L. SHARPE, Providence, R. I.

DEAR SIR: Permit me to express my thanks for your most interesting reply to my question relative to the micrometer. Following the clue your letter gave me, I find Mr. S. R. Wilmot, of the firm of Wilmot & Hobbs, of this city, and for many years Supt. of the Brass Co. gave the directions for the sheet metal gauges made at the Brass Co. Strangely enough, the last number of the *American Engineer* comes to hand with an article on this subject which I inclose. From its tone I judge Mr. Wilmot is responsible for it, my conversation with him perhaps being the indirect cause. I can see it would not have become the universal gauge it now is if B. & S. had not come to the rescue in the matter of graduation, for which I see the inclosed article gives no credit. Thanking you once more, I am,

Very truly yours,

F. A. STRONG.

THE ORIGIN OF THE MICROMETER.

As a popular measuring instrument nothing has been so widely accepted as the micrometer. Its advent has marked a very decided advance in mechanical accuracy. The time-honored calipers can give equal accuracy under certain conditions, but its great objection lies in the fact that there is no way to absolutely determine what measurement the calipers is set to, nor is it possible to re-set it to a given size without a comparison with an independent scale. The very fact that, barring the infinitesimal wear, a given size to a quarter of a thousandth can be always obtained by the micrometer, makes it of untold value. Its origin as a practical shop tool can be traced, as most useful steps can be, to necessity. In 1867 the Bridgeport Brass Company, Conn., in furnishing sheet metal to the Union Metallic Cartridge Company, of the same place, had a lot of brass returned as out of gauge. On investigation it was shown that the brass was to the gauge of the Brass Company, but that the gauge in the hands of Mr. A. C. Hobbs, of the Cartridge Company, and the one in the hands of Mr. S. Wilmot, of the Brass Company, did not agree; in short, all three gauges were proved by a fourth to be out. Mr. Wilmot saw at once that the same thing might be constantly occurring, and he said to Mr. Hobbs: "We will make this lot of brass to your gauge, but hereafter I will furnish all sheet metal to a given thickness, but you must allow me a certain variation, either above or below it, as we cannot, of course, turn out absolutely perfect work. Now, what percentage will you allow?" Mr. Hobbs thought it over and agreed to allow a plus or minus variation of 5 per cent., but, said he, "I don't see how the percentage can be satisfactorily determined." Mr. Wilmot answered he was tired of depending on a slit in a piece of metal for sizes, and would bring Mr. Hobbs a measuring instrument which would at once give percentage. Returning to his shop, Mr. Wilmot sketched the micrometer very much as now made by Brown & Sharpe Manufacturing Company, with these exceptions: The stem through which the screw passed was not split as now; the end of the screw was not hardened, nor was the fixed abutment, against which the article to be measured is placed, made adjustable for wear. But the thread of the screw was 40 and the division of the barrel 25, as now made. A pointer fixed to the main frame stood in the place of the present center line (see drawing, Fig. 3). Mr. A. D. Laws was then in charge of the mechanical work of the Bridgeport Brass Company, and to him Mr. Wilmot gave the sketch and told him to have six made. Mr. Laws gave the work to a very skilled machinist by the name of Hiram Driggs, who made them. These are in existence to-day, at least one of them is in use, and is in the possession of Mr. Laws. The Brown & Sharpe Manufacturing Co. received permission from Mr. Wilmot to make the micrometers, not that he claimed any patent or exclusive right to it, as the idea he thinks he got from a gauge which he saw in the works of the well-known printing press makers, Hoe & Co. In the year 1867 Mr. L. Sharpe, of the Brown & Sharpe Company, bought a micrometer gauge at the Paris Exposition, and as it was called "Système Palmer," it is to be supposed that a man by that name originated it. This micrometer, Mr. Sharpe says, is practically what they now make. The instrument that Mr. Wilmot saw at Hoe's was mounted on a bench and had a wheel and screw, the wheel being divided. The trouble which was encountered when the end of the screw was hardened by the thread warping was overcome by the Pratt patent, which made the end of the screw to receive a hardened plug by drilling a hole in it and forcing the plug in. This was a most valuable idea, and, to get around it, it is stated that a firm made a pin on the end of the screw and forced on it a hardened cap, but the law called it "substantially as described" in the Pratt patent, and sat on the firm.

From *The American Engineer*, Chicago, supposed to have been written by W. D. Forbes, Mech. Engineer, Bridgeport, Conn. [now of Hoboken, N. J.]

The *Financial News* (London) says the long-expected boom in American railway securities may come now at any hour. The American speculators, it declares, have not yet grasped the potential source of traffic expansion that will be afforded by the Chicago World's Fair. There is nothing extravagant in the estimate that $250,000,000 of foreign money will be left in America as the harvest of the exhibition. Americans will be literally burdened with money seeking investment.

MANUFACTURES

The old paper mills at Sauquoit, N. Y., are undergoing repairs.

The Bushnell Spring Co., of Poughkeepsie, N. Y., will locate at Easton, Pa.

The William Clark Thread Co., Westerly, R. I., is to add a new engine.

The Bowdoin Paper Co. will build another mill at Simpson's Rips, Me.

Lowell (Mass.) parties may establish a hosiery-mill at Augusta, Ga.

Parties are organizing a company to establish a cotton-mill near Chicago, Ill.

It is said that a new cotton-mill may be built by the Jonesboro (N. C.) Mill Co.

The Paul Whitin Manufacturing Co. is making an addition at Northbridge, Mass.

A corporation known as the Auburn Spring Co. has been organized at Auburn, Me.

The plant of the Pittsburgh Locomotive Works in Allegheny, Pa., is being rebuilt.

There is a plan of building a glass factory at Mohrsville, near Reading, Pa.

The Hoffman Wagon and Carriage Co., of Rochester, N. Y., has been incorporated.

The manufacture of hosiery has been started at New Orleans, La., by W. Gerhas.

Painter & Son are building a 24x140-foot foundry at their Myerstown (Pa.) plant.

The Lake Superior Iron Works, at Lake Linden, Mich., is building a new foundry.

The American Wood Board Co., of Thomson's Mills, N. Y., has been incorporated.

The Burke Tannery Co., of Morganton, N. C., has commenced enlarging its plant.

Phillips & Folke, of Dothen, Ala., are interested in a project to build a cotton factory.

A new shoe firm is about to begin manufacturing in the Hervey Lunt Factory, at Beverly, Mass.

The Canton Glass Co., of Marion, Ind., is constructing the foundations for its new plant.

The Hall Manufacturing Co. has recently organized at Rockland, Me., with $225,000 capital stock.

Improvements have been made at the machine shop of the Eastern Forge Co., East Deering, Me.

The United Projectile Co. is to establish a plant for manufacturing cartridge shells at Kokomo, Ind.

About ten acres of land have been secured for the new paper and fiber-mills, at Denver, Col.

The Harper Manufacturing Co., of New York, will rebuild its 12-set woolen-mill at Oxford, Me.

The Houston (Texas) Car Co. has been incorporated, to build car works; capital stock, $400,000.

A concern, to be known as the Danvers Electric Light and Power Co., is to be organized in Danvers, Mass.

It is said that seamless hosiery machines will be added to the Warren & Ferry mill at Apponaug, R. I.

The Young & Willover Automatic Mechanical Railroad Block Signal Co., Chicago, Ill., has been organized.

The Burrough Bros. Manufacturing Co., manufacturers of chemicals, will erect a factory at Baltimore, Md.

The Belle City Malleable Iron Co. has purchased, at Racine, Wis., the C. M. Jensen property, and will enlarge it.

A stock company is to be formed in Salem, Mass., for the purpose of putting the new double ratchet brake on the market.

The Nott Manufacturing Co., of Jersey City, N. J., making locks and latches, has been organized, with capital of $100,000.

H. Loven and others intend to organize a $35,000 stock company for the manufacture of cotton and woolen fabrics at Athens, Ga.

An enlargement which will increase capacity by 50 per cent. is being made at the Valley Knitting-mills, Mellenville, N. Y.

Ogden, Utah, is to have a glass factory, to cost $200,000, and be completed by January 1. M. D. Smith is the senior member of the company controlling the enterprise.

The Lancaster Carbon Co., of Lancaster, Erie County, has been organized, to manufacture electric carbon points and other electrical appliances and apparatus. Capital, $35,000.

The Kennebec Fiber Company are making extensive repairs on their mill at Benton Falls, Me., and building an addition on the river side of the mill, in order to gain more room.

The Home Novelty Manufacturing Company, of St. Louis, Mo., have filed articles increasing their capital stock from $20,000 to $30,000.

The stockholders of the Consolidated Electric Storage Co., New York City, have filed a certificate announcing that the capital stock of the company has been increased from $1,000,000 to $3,000,000.

The Sawyer Woolen-mills, at Dover, N. H., are adding a three-story brick building, 300x65 feet, for additional worsted machinery, which will about double their capacity for worsted manufacture.

S. S. Littlefield & Son, Wells, Me., have sold the sawing timber on their large wood lot lying on the county road leading to No. Berwick, to a company who are soon to put in a portable mill for its manufacture.

The Columbia Manufacturing Company, of Decatur, Ill., has been incorporated, with a capital stock of $25,000. It is the purpose of the company to engage extensively in the manufacture of clothing.

The Wapella Co-operative Creamery Company, at Wapella, Ill., was given articles of incorporation recently. The capital stock is $4,300, and the incorporators are Messrs. Jacob Parlin, C. D. Downing and others.

At Chicago, articles of incorporation were issued to the Brown Telephone and Telegraph Co., with an authorized capital of $5,000 000. The object of this company is to manufacture a telephone recently patented.

The American Aristotype Company has broken ground for an enlargement of its manufactory, which is located on Prospect street, Jamestown, N. Y. Two new buildings are to be erected, each 125x60 feet in size.

Craig & Scott, reed manufacturers, Lewiston, Me., are preparing to make extensive improvements. The building they now occupy is to be raised another story, giving them more room for their increasing business.

The Belem hosiery factory, in the City of Mexico, is putting in complete machinery for preparing yarn for knitting. The factory is worked by steam, and when the new alterations are finished it will turn out about 4,000 pounds of yarn per week.

The Lodge & Shipley Machine Tool Co., of Cincinnati, Ohio, are meeting with great success on their new pulley lathes, gear lathes and turret lathes. They have orders sufficient to keep them running for two months, and are constantly increasing their working force.

H. V. Loss, consulting engineer, Philadelphia, Pa., has issued a very neat catalogue setting forth the machines he will furnish, and the work he will do as a consulting engineer in the line of hydraulic engineering. The catalogue is certainly well worth having and preserving.

Messrs. Wendler & Spiro, engineers and architects, of Watertown, N. Y., have placed contract with the Berlin Iron Bridge Co. for steel structure for digester house at the mill they are building for the High Falls Sulphite Pulp and Mining Company, Potsdam, N. Y.

Representatives of a well-known manufacturing firm, which has extensive plants in Springfield, Mass., and Philadelphia, Pa., were in Portland, Me., recently, being about to extend their business, and having been induced through the agency of E. L. Smith to look to the Forest City as the site of their next plant.

Ground has been broken for a new harness factory at Randolph, Mass., to be occupied by C. Doughty, who now does a business at Augusta, Me., employing forty-five hands. The building is to be 90x50 feet, four stories, with an engine and boiler house. The land was given by the Randolph Power Co.

A combination of green-bottle manufacturers is to be in process of accomplishment. For some time past representatives of William McCulley & Co., Ihmsen & Co., Thomas Wightman & Co., and D. O. Cunningham have been looking for sites for their factories. Lately they have selected McKeesport, Pa., as the best location, and it is now understood that the firms named will effect a combination of interests and erect one large factory.

The People's Light and Fuel Co. has commenced work on an extensive improvement of its gas plant in Moline, Ill. The enlarged plant will have three times the capacity of the present one, or 150,000 feet of gas per day. The gas will be similar to that used in New York, Chicago, and other large cities, and is known as the enriched water gas. Its illuminating power will be 50 per cent. better than that of the present gas, or 24 candle-power.

Newport, Me., is intending to add to its enterprises by establishing a corn cannery in the village, and negotiations have already been entered into with Baxter & Brother, Portland, who have offered to locate there providing a suitable acreage can be secured, and if the citizens will erect buildings and lease them to the company for a term of years. Last spring this company built a canning factory in Vermont, and they have several other factories in Maine.

The Burgess Sulphite Fiber Company will build a large pulp mill at Berlin Falls, N. H., and a vessel is on the way to Portland, Me., from Brunswick, Ga., with 400,000 feet of hard pine to be used in the construction. The Burgess Sulphite Fiber Company was organized in Portland, and has named for the president of the corporation, Mr. Burgess, of Boston. W. W. Brown, of Portland, is one of the directors, and Thomas Edwards, treasurer of the Berlin Mills Company, is clerk of the corporation.

Efforts are still being made to raise a bonus of $100,000 for the construction of the proposed electric line from St. Louis, Mo., to Kirkwood. The members of the company promoting the scheme have been soliciting subscriptions from the property owners along the contemplated route, and have met with a fair share of success. The organization, of which Thomas Howard, of the Shickle, Harrison & Howard Iron Company, is president, is to be known as the Manchester Road Electric Railway Company.

There is water works agitation at Verona, N. J.; Campbell, Cal.; Bradford, Vt.; Hazardville, Conn.; Modesto, Cal.; Reading, Pa.; Toronto, Ont.; Norwalk, Conn.: Brooklyn, N. Y.; Sea Cliff, L. I.; Ridgefield, N. Y.; Galveston, Tex.; Vancouver, B. C.; Ridgefield, Conn.; Gloucester, Mass.; Tucson, Ariz.; Butte, Mon.; Grand Forks, S. D.; Rome, Ga.; North Hudson, N. J.; Mayville, N. Y.; Troy, N. Y.; Laurel, Md.; Dickson City, Pa.; Barnesville, Ga.; Canyon, Tex.; New Paris, O.; College Point, L. I.; El Paso, Tex.; Newport, Ky.; Rodeo, Cal.

The movement toward the re-establishment of the shoe manufacturing industry in Waldoboro, Me, resulted in a public meeting at Clark's Hall recently, at which $1,700 was subscribed toward that purpose. A committee was raised to solicit subscriptions, which now amount to $5,000. It seems to be understood that this amount is to be utilized either for purchase of machinery by the contributors, or by way of a loan to Mr. E. A. Libby, now or formerly of Richmond, who has recently been to town and had an interview with citizens, and who proposes to manufacture shoes there if satisfactory terms are made.

A meeting of the Portland (Me) Board of Trade was held recently in the interest of the Brooks Arms and Tool Company. The meeting was well attended by members of the board and citizens, and was called to order by President Winslow. Remarks were made by Edward H. Drake, of the company, who stated that they were anxious to establish a plant in Portland, and Mr. Lewis also spoke of the merits of the Brooks guns and rifles. Several subscriptions to stock were taken, and a committee of three experts were appointed to examine the Brooks guns and express an unbiased opinion as to their merits as compared with others.

Charles W. Bradford, of Clinton, Me., inventor of the Bradford self-closing telegraph key, has a valuable invention, and a stock company has been formed to handle it, with a stock of $500,000, and officers as follows: President, Charles W. Bradford; secretary, Forest J. Martin; treasurer, Howard W. Dodge; directors, C. W. Bradford, E. G. Hodgdon, W. T. Haines, H S. Goodwin, A. A. Shaw, H. W. Dodge, F. J. Martin. By the use of this key the annoyance and delay from careless operators leaving the ordinary key open is entirely obviated. The key has been examined and tested by leading operators, who indorse it as a valuable and practical invention.

The Cleveland Twist Drill Co., Cleveland, Ohio, write us: "It may interest some of your readers to know that we have just got out for a prominent engine manufacturing company of Pennsylvania, what we believe to be the largest solid milling cutter ever made. This cutter is 21 inches long, 5 inches in diameter finished size, with a 2-inch hole for arbor, and a keyway through the entire length. The steel in the rough state weighed 150 pounds. The anxiety which we felt when the big tool was ready to plunge into the hardening bath can better be imagined than described. That it was successfuly tempered and finished, without crack or blemish, we think speaks well for our facilities for handling this class of work. If any of your readers know of a larger spiral milling cutter than this, made from one piece, we would be glad to hear from them."

Machinists' Supplies and Iron.

NEW YORK, December 10, 1892.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $15 to $15.50; No. 2, $14 to $14.50; Gray Forge, $13 to $14. Southern brands of good quality are obtainable at $15 to $15.50 for No. 1 Foundry; $13.50 to $14 for No. 2; and $12.25 to $13 for Gray Forge.

Scotch Pig—Coltness is quoted at $21; and $20 for Eglington.

Antimony—The market is barely steady. We quote L. X., 11¼c. to 11½c.; Cookson's, 11½c. to 11¾c.; Hallett's, 10½c. to 10⅝c.

Copper—The market is firm. Considerable business in Lake Copper has been done at 12¼c., and some orders are still unfilled at this price. Speculative deals tend to lower the price. Small lots can be obtained from second hands at 12⅜c., although the asking price in first hands is 12½c. Casting Copper is held at 11¼c. to 11⅜c.

Lead—The market is dull and weak, with offerings at 3.75c. to 3.80c., the latter price for delivery during the next two months.

Lard Oil—Prime City is quoted at 85c. to 86c.; Western on spot at 83c. to 85c.

Spelter—The market is unchanged at quotations of 4.40c. to 4.45c.

Tin—The market is lower and weak, at ruling quotations of 19.75c. for December delivery.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. Seven words make a line, and the address as desired to appear should be included. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded

Wanted—6 machinists. Toledo, Ann Arbor & North Michigan Ry, Owosso, Mich.

Wanted—A good jobbing snap molder. Address Wickes Brothers, East Saginaw, Mich.

Wanted—Draftsman and machinist (25) desires a change. Address A., care AMERICAN MACHINIST.

Young machinist (21) good vise or lathe hand, wants position. Box 60, AMERICAN MACHINIST.

Practical designer, well up in theory, wants position as draftsman. Box 66, AMERICAN MACHINIST.

Wanted at Once—2 or 3 thor. comp't locomotive draftsmen. State age, exp., salary required, with refs. Brooks Locomotive Works, Dunkirk, N. Y.

Wanted—Foreman, good mach., for Western factory. One understand'g foundry work preferred. C. H., AMERICAN MACHINIST.

Wanted—Position as sup't or foreman; successful in the systematic mfg. of machine tools, automatic & interchg'ble mach'y. H., Box 310, Florence, Mass.

Wanted—Tool makers, punch and die makers. Address the Superintendent of the Schneider & Trenkamp Co., Cleveland, Ohio.

We are in immediate want of a good mechanical draftsman. Address, giving reference, stating experience, and wages expected, Box 61, AM. MACH.

Wanted—Position by a young draftsman, with technical education and two years' experience in general machinery. Box 62, AMERICAN MACHINIST.

A first-class mech. draftsman of seven years' exp. wishes position; New York City preferred; is a tech. grad. N. S. H., 62 Niles St., Hartford, Conn.

Draftsman thor'ly conversant with gas works construction & apparatus, electrical work, tools & fixtures, etc., desires pos.; refs. H. M., AM. MACH.

Practical engineer & machinist with theoretical knowledge wants situation as an engineer, or to put up mach. or factory, etc. Address E., AM. MACH.

Wanted—Foremanship of foundry; well recommended; light or heavy castings; 18 yrs. foreman on chilled car wheels. Foreman, Box 65, AM. MACH.

Wanted, Immediately—Two first-class machinists, one pattern maker and one draftsman. Apply, stating experience, and wages expected, to Kenney & Co., Scottdale, Pa.

Wanted—By a young machinist and tool maker of ability, a position to take charge; familiar with modern methods of manufacture; good experience and good references. Address Box 64, AM MACH.

First-class blacksmith and hammersman desires situation as foreman; experienced in designing dies for drops and steam hammers; strictly temperate. T. B., 10 Madison Terrace, Paterson, N. J.

Wanted—Young man with some knowledge of mechanical drawing as assistant draftsman; would prefer undergraduate, or graduate of technical school. Address Box 54, AMERICAN MACHINIST.

Wanted—A first-class draftsman competent to take entire charge of our drawing-room. Address, stating experience, and salary required, Sioux City Engine Works, Sioux City, Iowa.

Draftsman and designer is open for engagement Jan. 1. Have had practical exp. in shop, and the design of shop tools, etc. Can supt'd erection and handle men. Mechanical Engineer, AM. MACH.

Wanted—Draftsman and designer, with machinists exp. to relieve Supt. when necessary. State nationality, age, exp., refs., salary exp'd, and how soon could report. Charter Gas Eng. Co., Sterling, Ill.

Wanted—A 1st-class mach'y salesman, familiar with modern single-valve automatic engines, and gen. power requirem'ts for electric light & railway service. State exp., salary exp'd. Box 63, AM. MACH.

Wanted—Foundry foreman, 1st-class mechanic on all kinds of machinery, capable of handling men to advantage; two years' experience as foreman. Address G. D. L., care AMERICAN MACHINIST.

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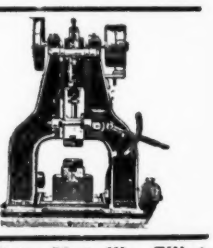

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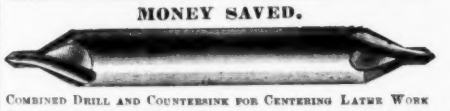

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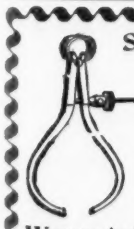

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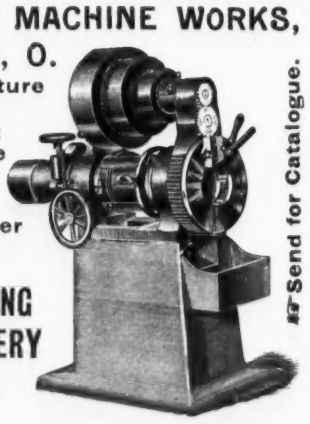

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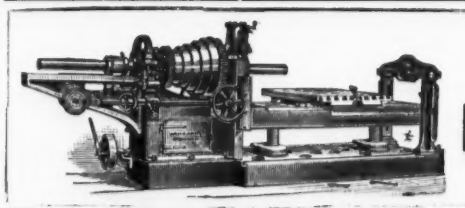

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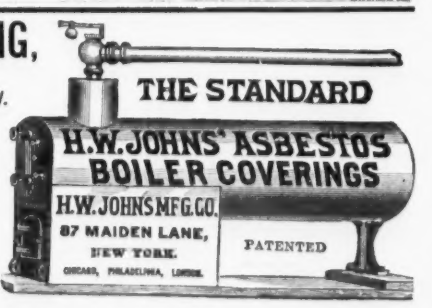

Wanted—Die makers on tinware and sheet metal dies; also A1 man to take charge of die department; permanent situation to first-class men: none others need apply; state experience, and wages expected. Address The Toledo Machine & Tool Co., Toledo, O.

Wanted—An active, ambitious young machinist who is ready to go onto a printing press erecting floor and learn the business with a view to taking charge of the work. Address, giving age and references, New York, care AMERICAN MACHINIST.

A competent planer hand wanted; one that is accustomed to doing light, close, accurate work; must be of good habits, and reliable; to the right person will be offered a steady position; state age, wages, and experience. Address R. M. Co., AMERICAN MACHINIST.

Wanted—Foundry foreman capable of taking charge of a foundry making heavy machinery castings & rolls; must be a sober, intelligent & energetic man and a good handler of men; give references and state what salary would be expected; an American under 45 years of age preferred. Address Foundry, Box 57, care AMERICAN MACHINIST.

Wanted—Machine shop foreman, by a firm manufacturing heavy machinery; must be of sober, industrious habits and good mech'l abilities, capable of handling men to the best advantage and producing first-class work at minimum of cost; an American under 45 years of age preferred; give references and state what salary would be expected. Address Machinery, care AMERICAN MACHINIST.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 25 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d-hd lathes & planers. S.M.York, Clev'd, O.

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The *Engineering Record*, the recognized authority on Municipal and Building Engineering, has recently been enlarged by the addition of a department in which notable industrial plants are regularly described and illustrated, the steam and power plants being a conspicuous feature. Recent publications include the great Ivorydale plant of Messrs Proctor & Gamble, described in 23 columns and illustrated by 57 drawings. The steam plant at Ivorydale is separately treated in 18 columns and 31 drawings. The New Foundry of Henry R. Worthington, at Elizabethport, N. J., 16 columns, 26 illustrations. National Meter Company's Foundry and Brass Finishing Shop, Brooklyn, 13 columns, 29 illustrations. Niagara Power Plant (now in process of publication), 6 columns, 6 illustrations. Steam Power Plant of the Dwight Manufacturing Co., Chicopee, Mass., 9 columns, 7 illustrations. Published Saturdays 12 cents a copy. The *Engineering Record*, 277 Pearl St., New York.

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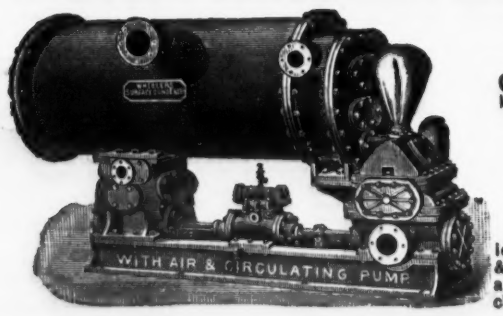

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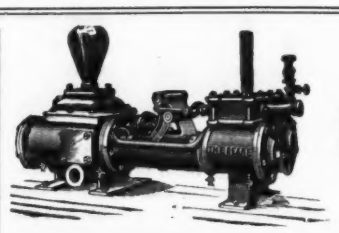

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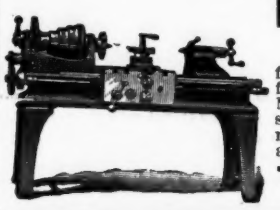

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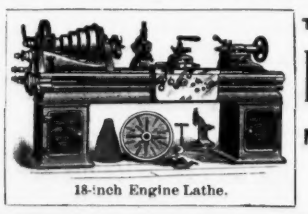
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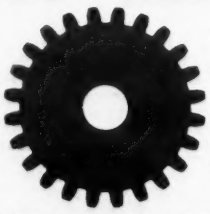

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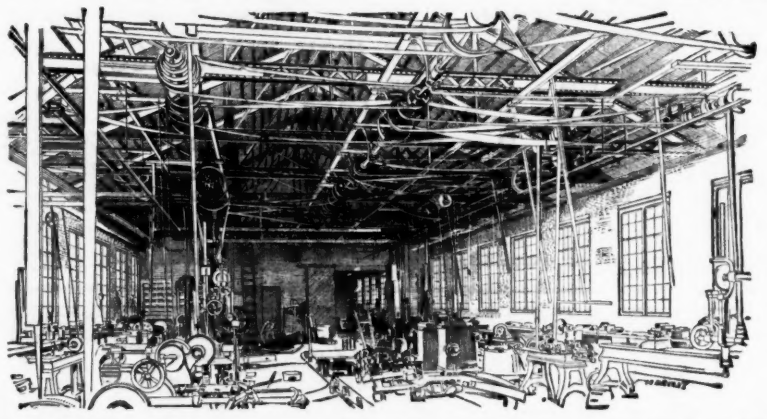

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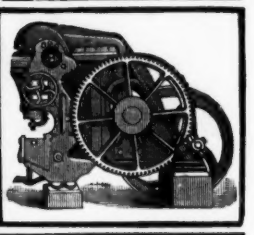

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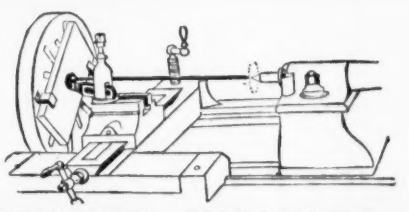

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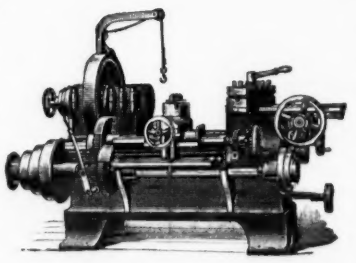

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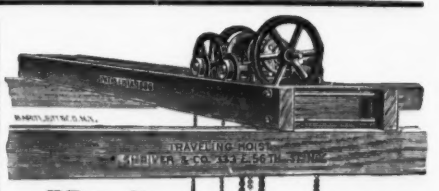

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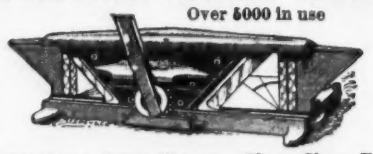

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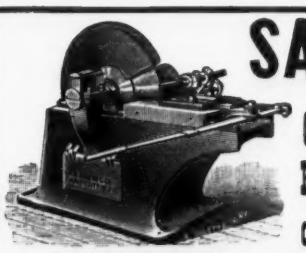

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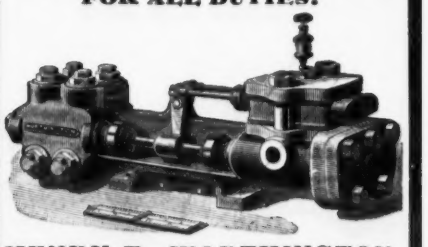

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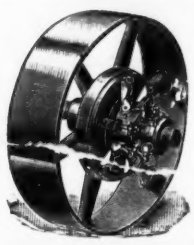

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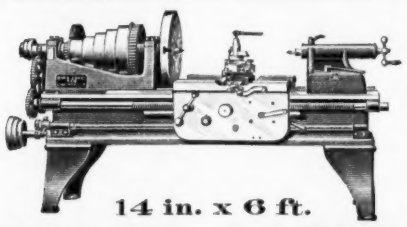

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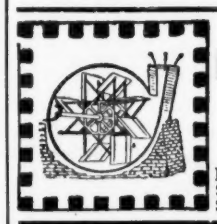

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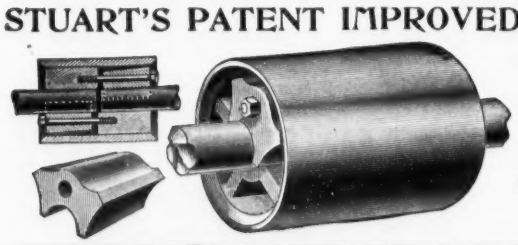

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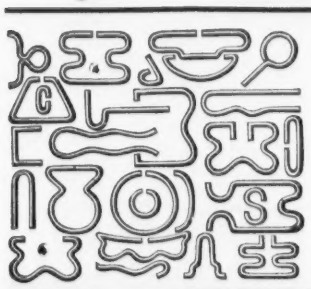

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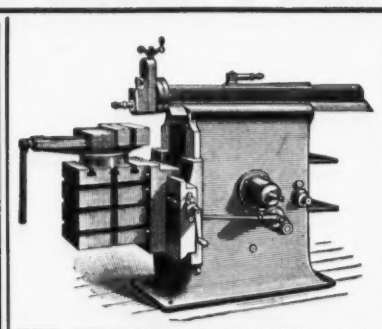

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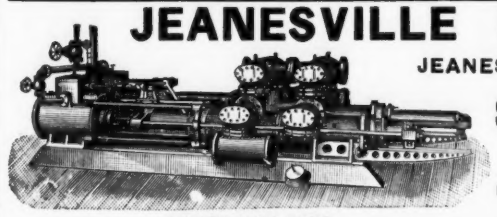

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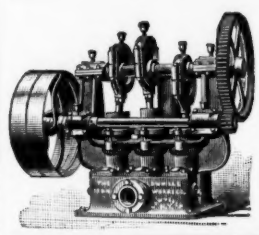

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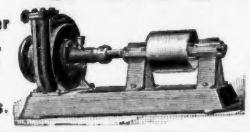

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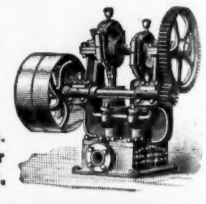

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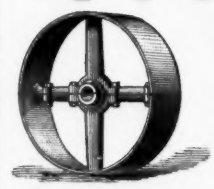

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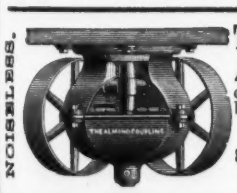

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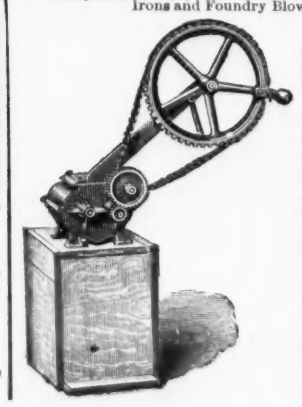

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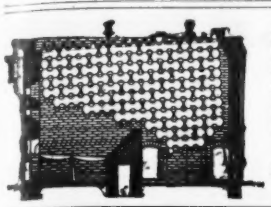

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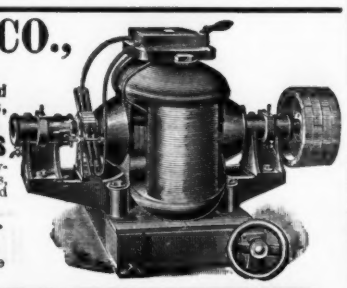

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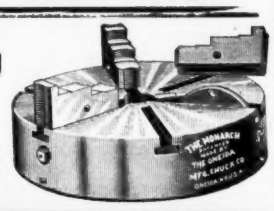

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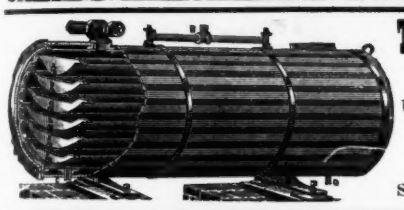

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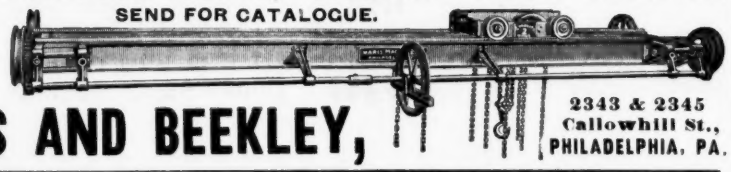

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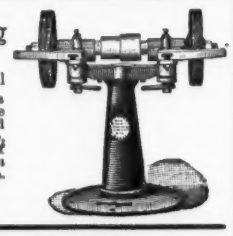

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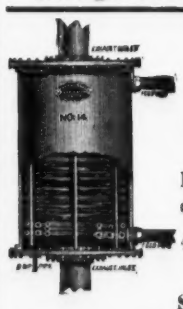

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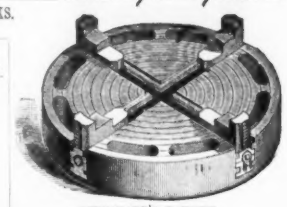

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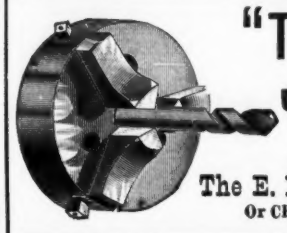

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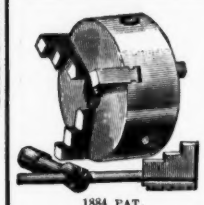

1884 PAT.

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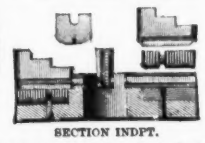

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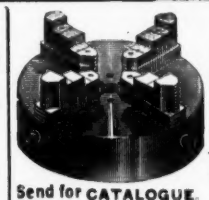

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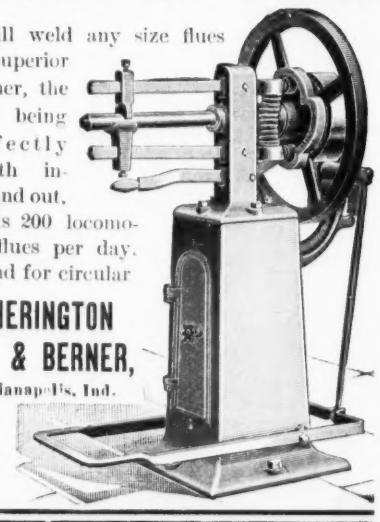

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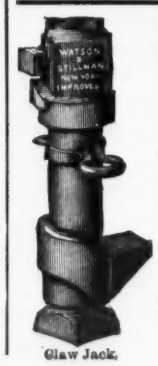

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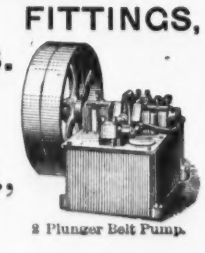

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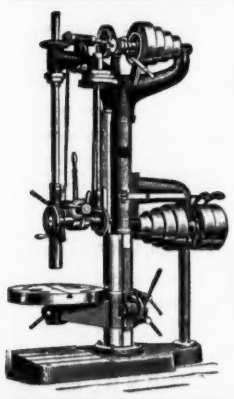

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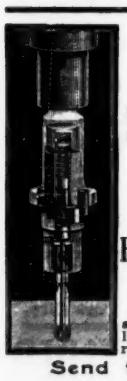

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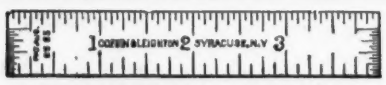

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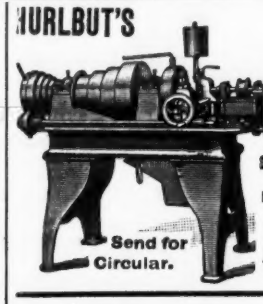

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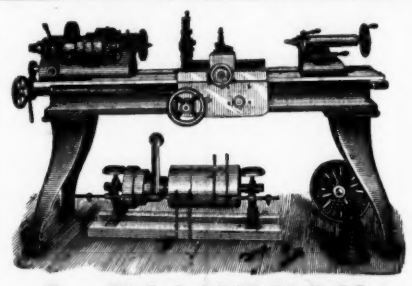

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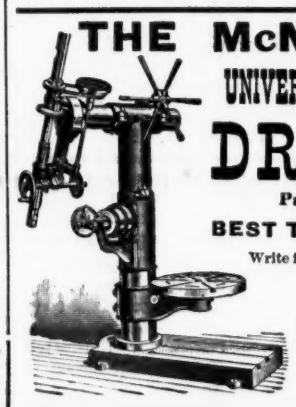

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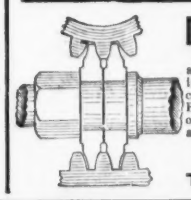

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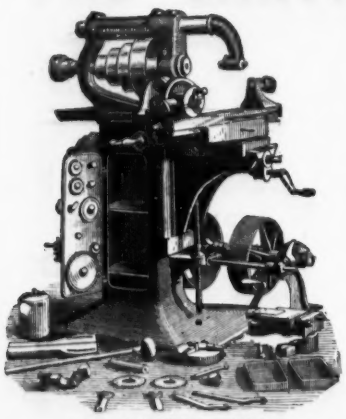

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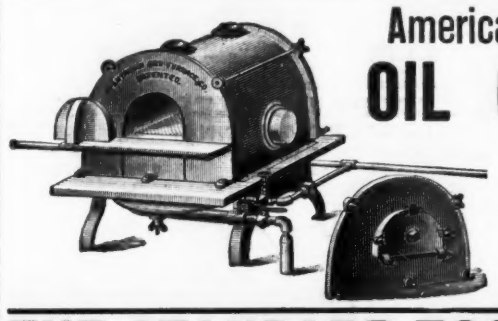

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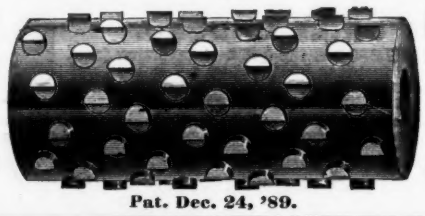

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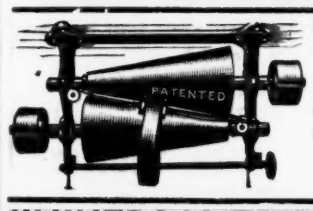

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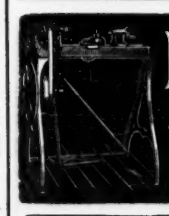

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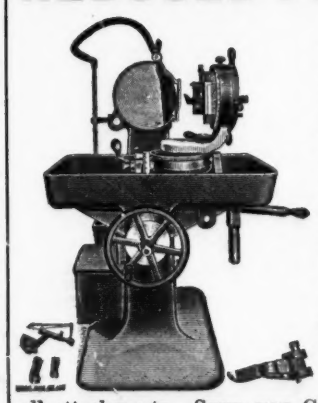

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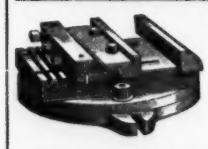

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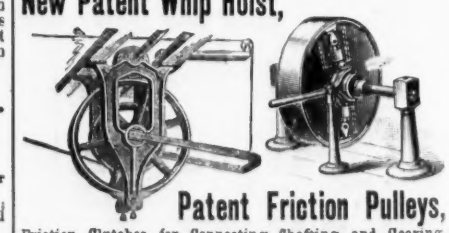

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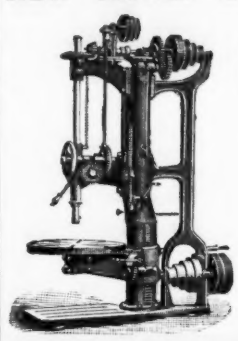

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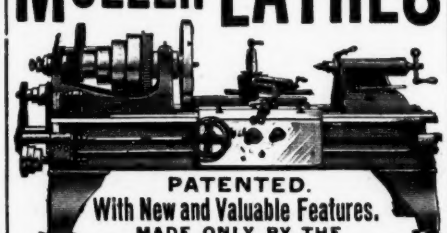

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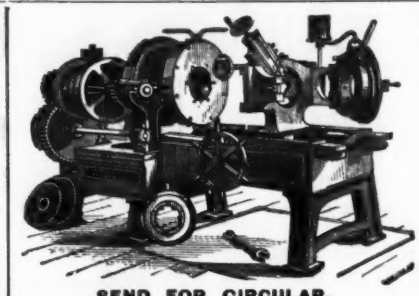

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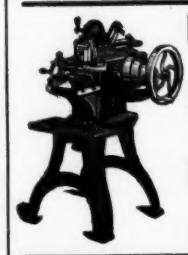

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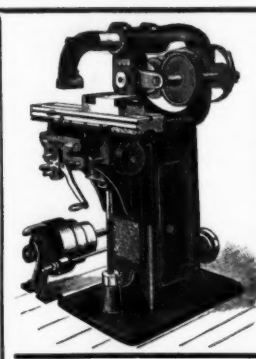

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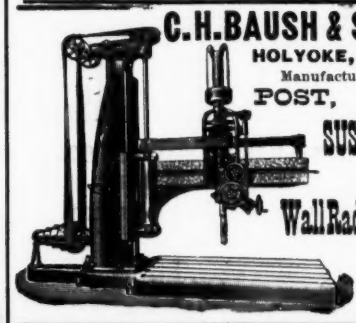

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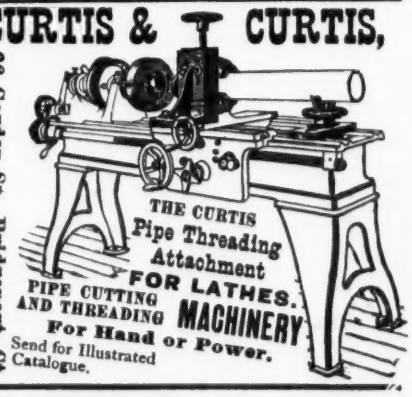

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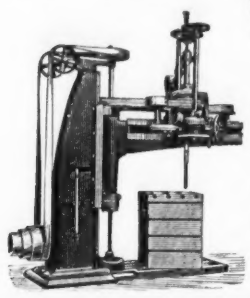

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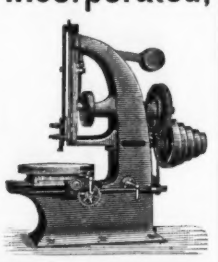

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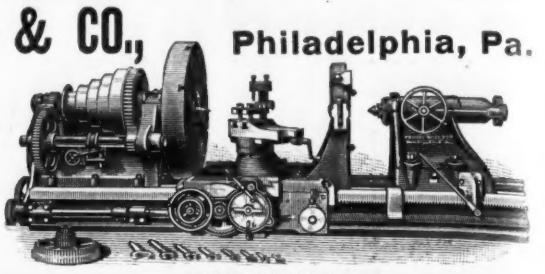

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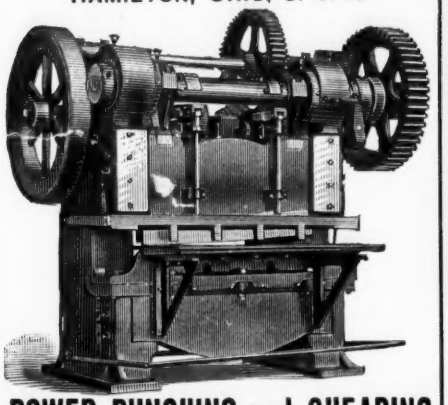

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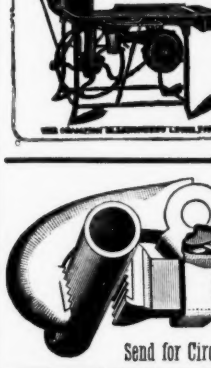

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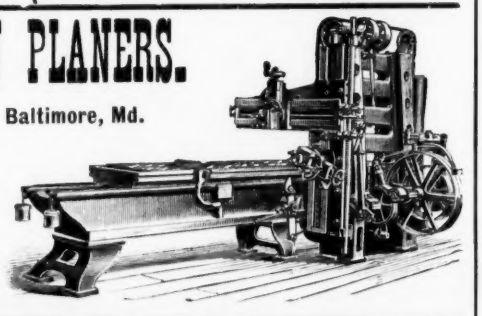

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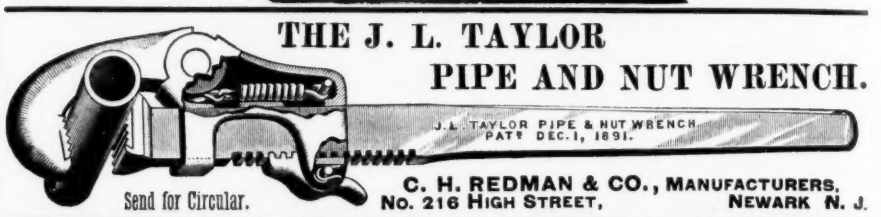

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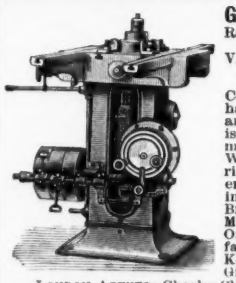

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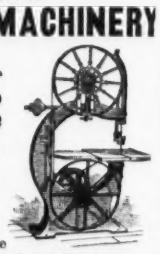

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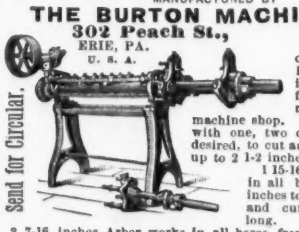

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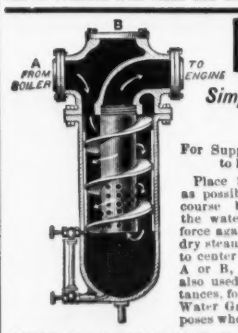

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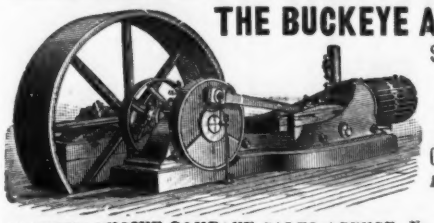

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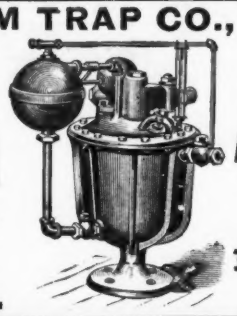

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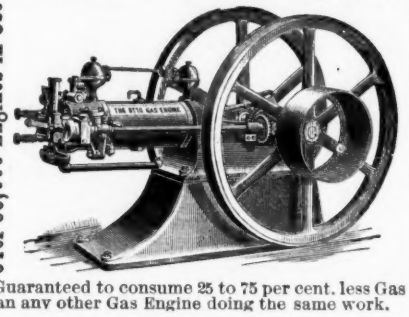

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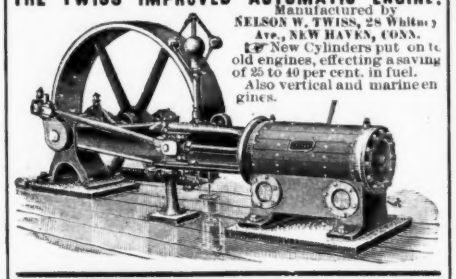

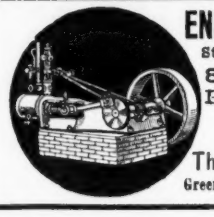

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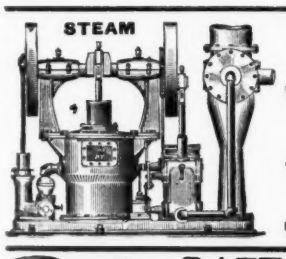

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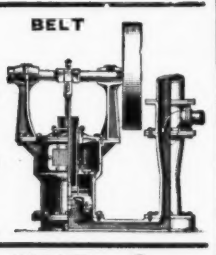

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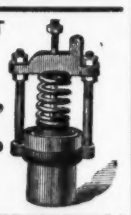

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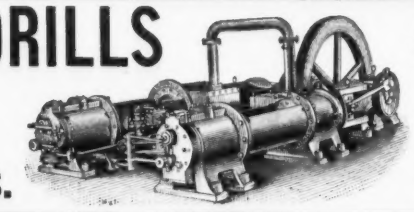

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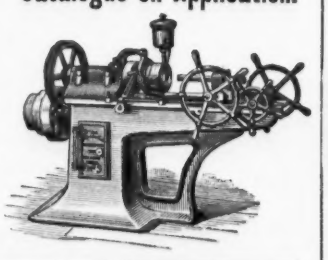

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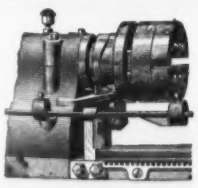

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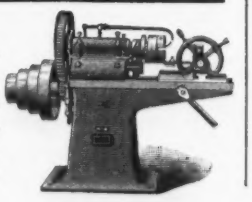

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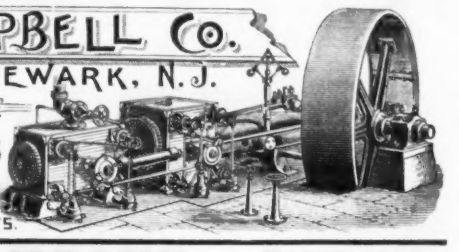

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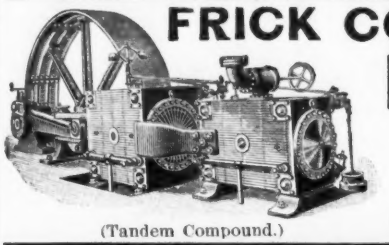

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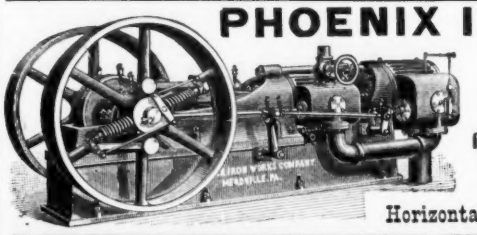

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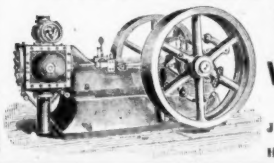

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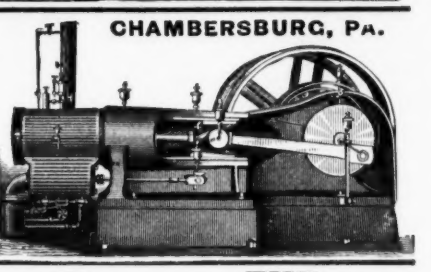

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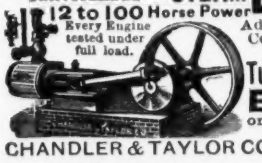

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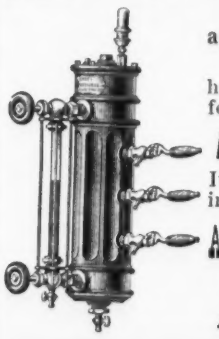

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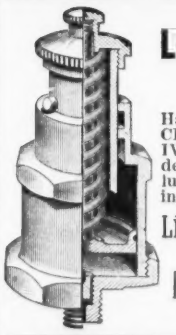

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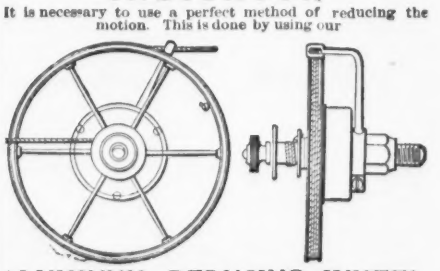

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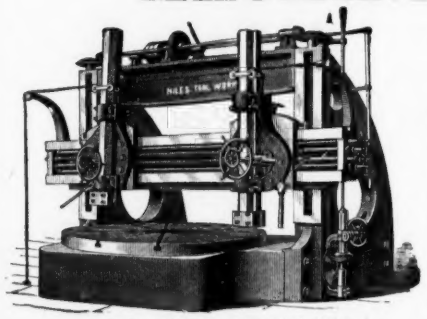

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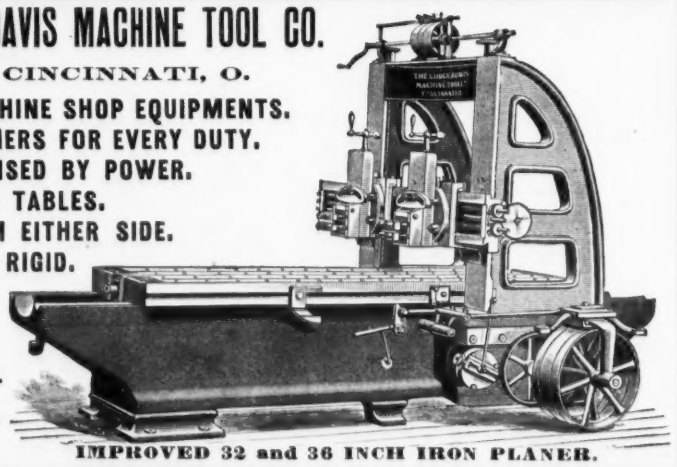

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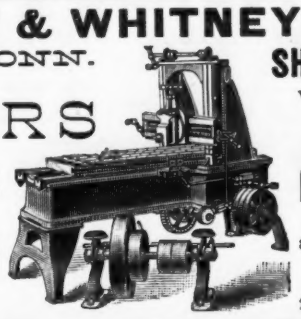

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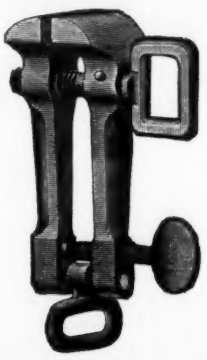

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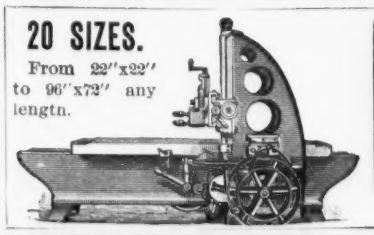

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